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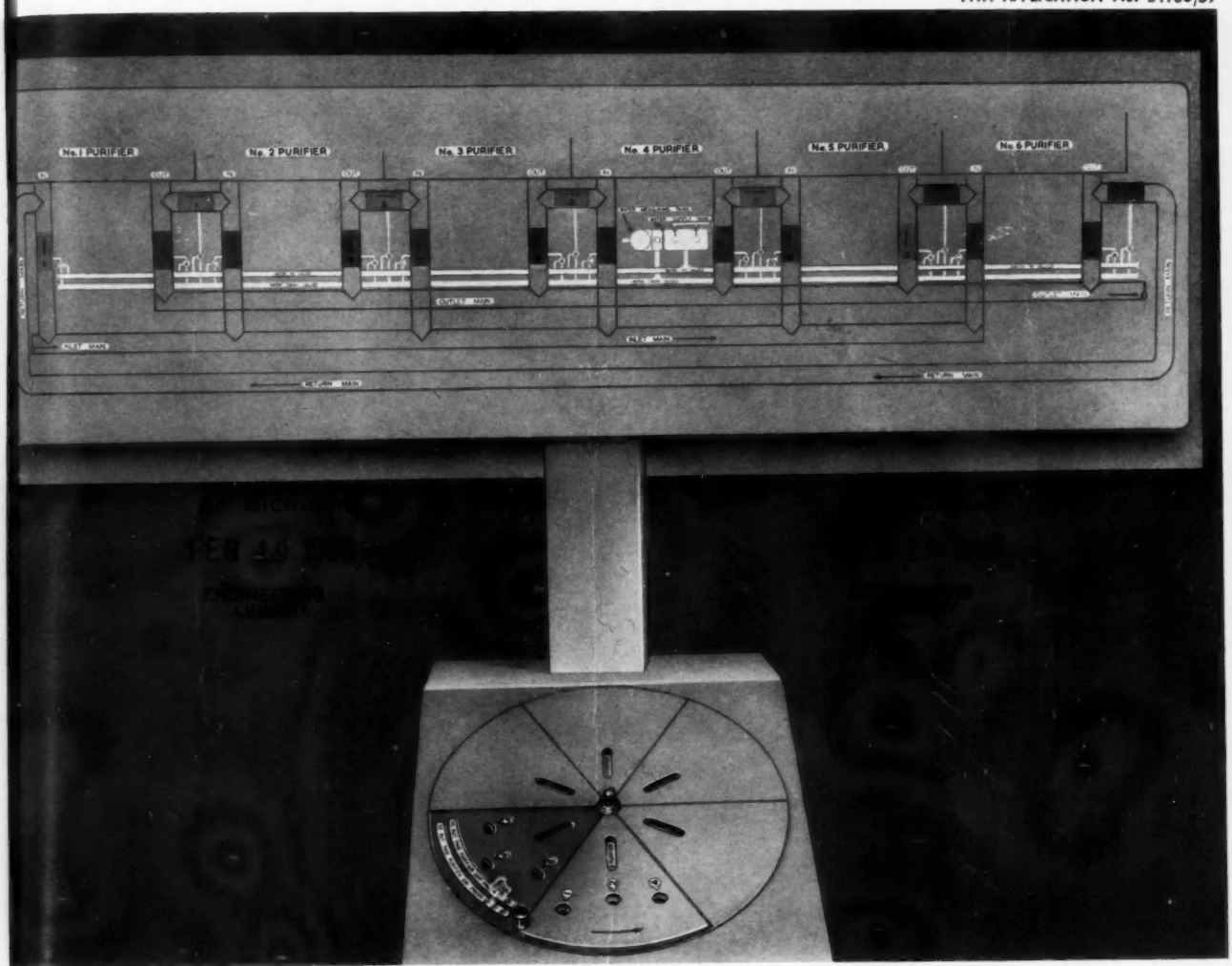

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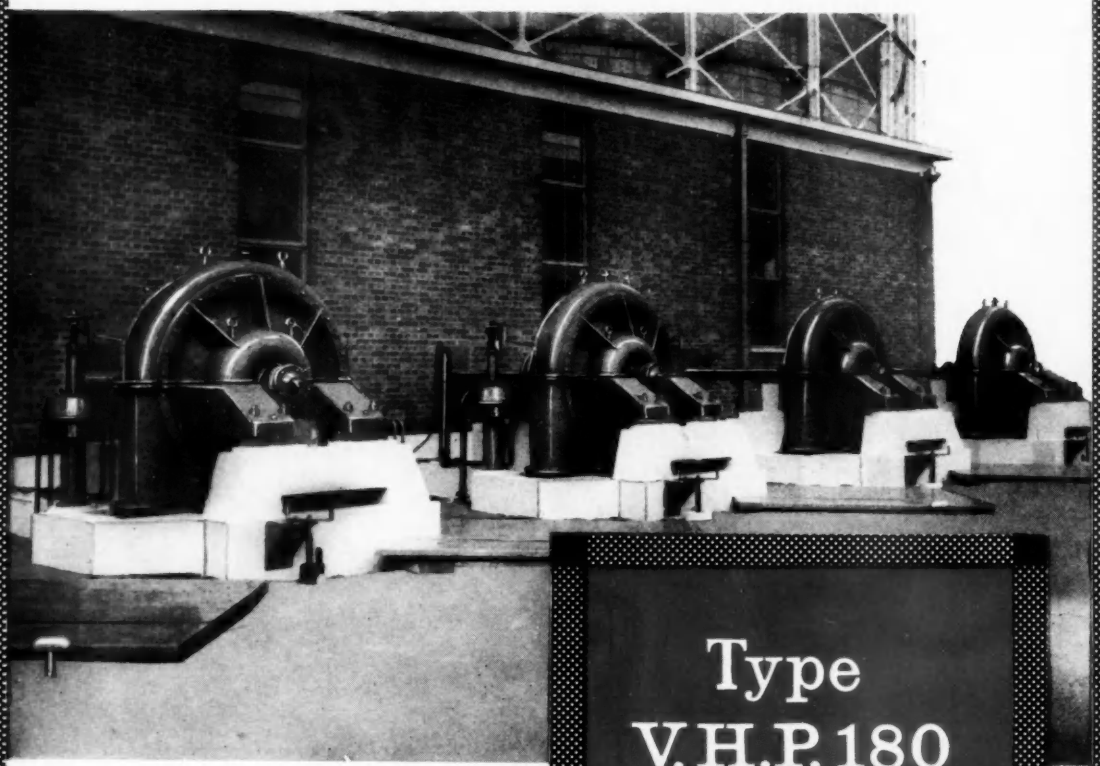

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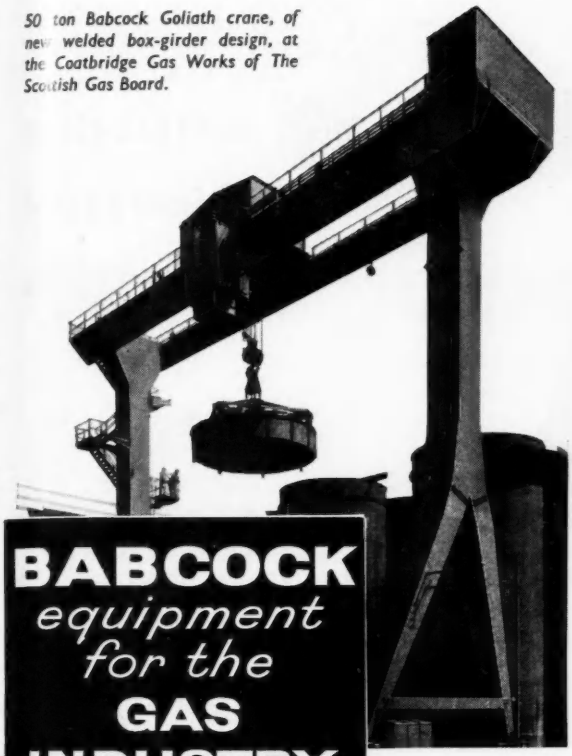

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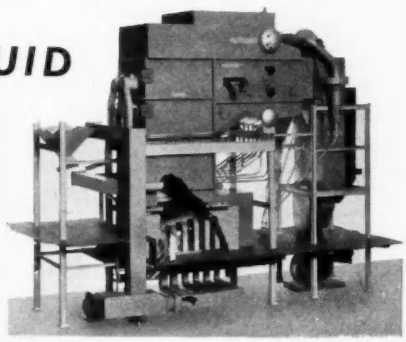

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Gas Journal

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Gas Journal

COKE OVENS • BY-PRODUCTS • CHEMICALS

Gas for industry—an untapped potential

WHAT an extraordinary industry this is ! It took the gravest danger of pricing gas right out of the market to bring about the flurry of technical development which has characterised the last few years. On the production side the industry has done, and is doing, astonishingly well, exploring concurrently a variety of avenues any one of which might lead to an economic solution. But this has always been an engineers' industry—' engineer dominated ' is the much quoted phrase we coined a few years back—and the result is that its progress is entirely lop-sided; the production side is forging ahead in spanking style while the sales side lags behind. So timid is the commercial approach that such innovations as two-part tariffs and commission for salesmen—methods familiar in the outside competitive world for donkey's years—were hailed as developments of world-shaking originality. So they were by gas industry standards, and while we would be the last to deny their importance in the scheme of things or to ridicule the efforts of those who instituted them in our traditionally conservative climate, it can hardly be denied that there was something very naïve about the excitement attending their introduction. What troubles us is the apparent lack of basic thinking about gas sales. A good deal of attention has been given to finding ways and means of selling appliances in the domestic market, but what seems to be lacking is the taking of the basic decisions which should precede that kind of activity.

It has been said by various eminent people in the industry, from the Chairman of the Gas Council downwards, that we must sell to live, that only by selling gas can the price of the fuel be stabilised, let alone reduced. Yet gas sales are slowly declining and brave excuses about warm winters, more efficient appliances and the various other explanations trotted out each year cannot disguise the fact. Somehow the decline must be arrested, and quickly. But how? Surely by concentrating the maximum effort on building the load or loads capable of being developed in the shortest time, with the least effort and at the lowest cost. That can mean only one thing—industrial gas.

Sales of gas to industry represent some 30% of total gas sales (the commercial load accounts for a further 15%), and for their contribution to the industry's economy they receive a ridiculously small amount of attention. Not, we hasten to add, from the industrial gas engineers who are in most cases dedicated to their cause, but from those responsible for seeing that this valuable side of the industry's business receives the encouragement and support it deserves.

It is difficult to understand why this should be so, unless it is that industrial gas engineers are busy men, almost always understaffed, whose time is so taken up with doing their day-to-day job that they lack the time, the opportunity and sometimes perhaps the ability to attract to themselves the attention and support given to their colleagues on the domestic side, by whom they are completely outnumbered.

In some respects the industrial gas load is the most vulnerable. It is dependent on economic prosperity, the merest suggestion of a slump making its impact felt on gas sales almost as quickly as on, for example, the demand for steel. This country has been enjoying an unprecedented boom and there seems no reason to suppose that it will not continue. Now is the time therefore to capitalise on an expanding economy and see that gas gets its share of the business. But the industrial load is vulnerable for another reason—competition from other fuels, notably oil and liquid petroleum gases. As we know, the oil industry is growing at an astonishing rate, thrusting its tentacles into an ever widening field of utilisation. The price of its products, particularly when, as happens in the case of l.p.g., it is considered in relation to the quality of service provided, is extremely dangerous to gas interests. With the pattern of this hydra-headed competitor's intentions abundantly clear, it must surely be admitted that *now* is the time for a tremendous drive on the part of the town gas industry.

We know of cases where gas is holding its business on the strength of nothing more than a superior personal service. It can only be a matter of time before our competitors are in a position to offer an equal personal service; certainly they are well aware of its importance and are taking active steps to remedy the situation.

For far too long industrial gas has hidden its light beneath the traditional bushel, and it is only recently that there has been a marked increase in the publicity given

to this essential service. This is good to see, but it is only a beginning. It will take a great deal of work—and a good deal of money too—to ensure that the benefits of gas in industry are brought to the notice of all potential users. But important as publicity undoubtedly is, the fact remains that it is only a sales aid. Something more fundamental is called for and this cannot be achieved without more personnel. This is the real key to the problem. There are not nearly enough industrial gas engineers in the industry and at present recruitment is so unsuccessful that the average age of the industrial men in at least one board is 50. Unless something is done to make the profession more attractive the industrial gas load will face yet another peril—a shortage of manpower so acute that existing business will slip from our grasp simply for want of attention.

And new business? How can the industry explore the thousand and one new opportunities which are waiting round the corner? Indeed, how is the industry to know where such opportunities are to be found? We believe that the industrial staff throughout the industry could and should be doubled. This could only be achieved by offering salaries sufficiently high to attract the right men to this specialised service. At the moment we are losing some of the most promising men to the oil industry. How can we hope to compete for business on the factory floor until we can compete on the labour market? The type of men we need hold qualifications which entitle them to something a good deal better than we can at present offer them. It is a short-sighted organisation which fails to accept the fact that there is nothing expensive about getting the best men.

Given a much stronger industrial sales force several vital things become possible: The proper exploration of the new business potential; more frequent calls on existing consumers, giving a better service and doubling the chances of picking up further loads; the progressive planning of sales over the years ahead. We believe that, given the proper financial inducement, the augmented sales force needed could be found, trained and in full operation within one to two years. The effect on the industrial load would be dynamic. The effect on the overall sales picture would be to check the present draining away of business and in consequence to produce a beneficial effect on the price of gas.

Changing demands for energy

SINCE the second world war there have been many estimates of the future demands of energy in the United Kingdom. Conflicting figures have been given for the coal, or the coal equivalent of other fuels, needed by the 1970's. Steps have been taken to find means of providing energy without consuming a greater amount of coal than that provided by our own coal industry. The generation of electric power by atomic energy has been developed and other fossil fuels have been imported.

The fuel industries, however, whether they are supplying the basic forms of energy such as coal and oil, or the secondary forms, gas or electricity, need periodically to take stock and to consider in what way the trends discernible at any given time are likely to influence the future.

In his address to the Fuel Luncheon Club last week, Sir Harold Hartley discussed these particular points and showed how new developments in conventional fuel usage might influence the shape the fuel world was likely to take both in the short and the long term.

It was only in 1956 that many were profoundly disturbed by the 'energy gap' and how it was to be bridged, but the mild recession in world trade has temporarily caused something of a fuel surplus and the short-term picture had completely changed. Not only has there been a drop in demand for fuel generally, but the pattern of demand has also completely changed. Coal consumption has fallen by 3%, but oil consumption has risen by 12% per annum. Coal prices rose 7% per annum until 1958, since when they have remained almost constant, while oil prices in the United Kingdom, disregarding the abnormal circumstances of the Suez crisis, have risen 4% per annum; the average prices of gas and electricity have risen about 5% and 3% per annum respectively.

Although there is no longer a shortage of energy in the United Kingdom, the fuel industries are showing the most intense activity. Seldom if ever has so much been done to develop means of production which will ultimately lower costs. Though the last two years have seen a surplus of coal and the stocks rising dangerously at the collieries, the development programme for the mechanisation of coal mining and coal treatment has been going forward at full speed. The work put in hand over the years since nationalisation is coming to fruition and costs are remaining reasonably steady. At present increases in productivity, the price of coal might well become competitive. The gas industry has made big strides in developing new processes and successfully exploiting new sources of raw materials. The efficiency of electrical generation has improved so much that electricity from atomic energy is having increasing difficulty in competing with its counterpart from thermal stations. Since the war the oil industry has built refineries near to centres of consumption and the new techniques of hydroforming and platforming have not only improved the quality of the product but also provided a more efficient means of production, allowing surplus products to be used increasingly for the manufacture of petrochemicals. Great developments have taken place in the exploiting of oil wells in North Africa which will underwrite oil supplies for Europe, and a large source of natural gas has been discovered in the Pyrenees.

The recession in world trade would seem to be passing so that the demands for energy at an even greater rate than previously may well have to be met in the near future and the developments we have referred to should be ready to cope with these increased demands when they come. How is the gas industry going to be affected by these heavy demands for energy?

Sir Harold thinks that with all the advantages it offers, gas should have a good future provided it can be made at the right price. We are clearly up against our usual

stumbling block. How can the industry be sure of being able to make and sell gas at the right price? If this particular problem can be solved, the future of gas is assured. Even at today's prices the preference for gas by large users in industry is symptomatic of its high efficiency and convenience. Sir Harold goes on to discuss the modern means of gas manufacture by complete gasification, hydrogenation and the use of both coal and oil. The production of producer gas and synthesis gas both have their places in the future energy scheme, he thinks. A new use for gaseous fuels might be the smelting of metals in place of coke.

So important are these developments in fuel usage that Sir Harold considers that they should have greater parity with atomic fission and thermonuclear research. Coal is our native fuel and its reserves all over the world are probably far greater than oil or natural gas. Exploit means of processing it and we feel that gas too will fall in price and ultimately become more competitive to supplant oil in the long term.

Commentary on the News

Panned by the purist

WE have written much in recent months of the importance of getting the gas story over to architects and builders. The essence of our remarks has been the need to supply these influential people with hard facts and figures concerning the merits of modern appliances. But it would be as well to remember that in catering for the architectural profession (in particular) we are dealing with people some of whom have high æsthetic standards and are perhaps a little intolerant of anything which does not exhibit the marks of good contemporary design.

Take as an example the reception accorded the third edition of the Gas Council's Coke-burning Appliances Handbook by *Architect and Building News*, a journal which wields plenty of influence in the circles for which it caters. The reviewer states: 'It is undoubtedly useful and represents a good deal of hard work, admirable co-operation, good will and so on. But, as a piece of modern book production, it does not rank very high. Compared, for example, with the latest publications of the C.U.C., it is like some Victorian ironmongery catalogue. Many of the plates are poor and appliances are swamped in ghastly fire-surrounds, the typography is, to say the least, undistinguished. The whole book needs redesigning—it would make it even more useful and a pleasure to use as well.'

Is the criticism justified? From a purist point of view it probably is, but we should have thought that the mass of genuinely useful information provided would have outweighed the fact that the information is clothed in a rather uninteresting manner. However, branding the reviewer spiteful and wilfully preoccupied with secondary values does not alter the fact that humdrum production has perhaps damned the handbook in the eyes of many influential people. In other words, if we are to get our message over to architects we must not only talk their language but dress according to their standards of taste.

Sir James changes his mind

ONE of the most interesting remarks made by Sir James Bowman, Chairman of the N.C.B., recently concerned the Board's attitude towards oil, and was reported in the *Manchester Guardian*. Asked whether the Board would welcome a tax on fuel oil, Sir James replied: 'The last time I was asked that I replied "No," but now I think the situation might alter so drastically that I cannot commit the Board to definite policy on that.' He pointed out that the Germans were now considering a 50% tax on fuel oil, and Austria had already imposed a tax. 'If that were to mean an unloading on Britain of oil which would normally be sold in Europe, the Board might have to change its policy. We reserve our position and will study the situation as it develops.'

Obviously the N.C.B.'s anxiety about competition from oil is growing, and if it reaches a point at which the Board actively campaigns for a tax on oil, the gas industry will become very interested indeed. A tax of this nature could improve the competitive position of gas.

Unsolicited testimonial

AT the Southern Gas Board's area Sales Circle meeting, held at Bournemouth recently, Mr. J. F. Doran presented an admirable paper entitled 'On the Move' in which he sought to show the gradual draining away of business as a result of people moving house. In effect he said: Find out when and where people are moving, act quickly to ensure that they do not change their affections from gas to another fuel, and you will do much to arrest the decline in the domestic load.

Mr. Doran's reasoning is sound and we thought of it this week when we read in one of our local papers—the *Bucks Free Press*—a letter from a Mr. David M. Howick. In an age of grouses about the nationalised industries it was good to note that at least one industry—fortunately our own—is on its toes. We reproduce the letter in full:—

'We are shortly to move into a new house in Sheepcote Dellroad, Holmer Green. The Gas Board office in High Wycombe has sent us full details of services they can offer and suggested that rather than put us to the inconvenience of going into High Wycombe, they would send a representative to see us. As a result, all arrangements have been made for our gas supply and we have bought our cooker.

'On the other hand, we were forced to take the initiative and call on the electricity office in High Wycombe. When they discovered that our house is in that part of Holmer Green which does not come under their care(!), they immediately lost interest in us and were unable even to let us know where our office is.

'They made two suggestions (Chesham or Reading) both of which have turned out to be wrong.

'We are newcomers to the district and before all this were uncommitted over the appliances we wanted for our new house. We would like to say that after our experiences we will certainly get all appliances we can from the Gas Board since it is obvious that their service is so much better.'

The moral is obvious. If the Gas Board—in this case the North Thames—had not acted promptly and effectively this consumer might have been lost to electricity, for good. That is the point: Losing a consumer is easy; getting him back can be very difficult indeed.

FROM A UNITED NATIONS E.C.E. WORKING PARTY REPORT

THE QUESTION OF UNDERGROUND GAS STORAGE IN EUROPE

2.—Economic problems

THE first part of this report has shown that by reason both of the physical and technical characteristics of these reservoirs and of the functions they perform in different gas systems, it would be unrealistic to make a comparative study of them from the economic point of view. The economics of each reservoir, therefore, will now be discussed and finally an attempt will be made, on the basis of these diverse if not disparate elements, to distinguish the main economic problems which arise when plans are made for building an underground storage field. In each case, capital outlay and operating costs will be examined in turn, and the economic advantages of underground storage over other methods will be very briefly indicated.

In the Reitbrook underground storage field the capital outlay of about 6.63 mill. DM. (£568,000) is for testing, first installation costs, and the construction of the compressor station and the pipe-lines connecting it to the storage field, while the value of the gas cushion is estimated at 2.8 mill. DM. (£240,000).

At the time when the reservoir was first being filled—at the rate of only 1.8 mill. cu. m. per month—the operating costs, per cu. m. of gas, amounted to 4.3 pfennig for gas at 6,550 kcal. per cu. m. (3.6d. per therm of 690 gas) equivalent to 2.7 pfennig for gas at 4,200 kcal. per cu. m. (2.3d. per therm of 443 gas). Such, then, is the additional cost of supplying supplementary gas for the winter, over and above the cost of the basic gas from the refinery. It is estimated, however, that when the storage field is functioning normally, the cost might be reduced to 2 or 2.5 pf. per cu. m.

Rough calculations have been made to determine the saving which can be achieved by using underground storage in preference to other methods. It was mainly a matter of finding how much it would cost (including depreciation and financial charges) to operate an underground reservoir, as compared with the cost of running flexible production units to supplement the coke ovens and enable them to operate with an optimum load factor. The conclusion reached was that the underground storage field would enable the supplementary gas to be produced at a cost 20% lower than that of the gas produced by supplementary production units.

Table 2 indicates the distribution of the capital outlay for the Beynes field, as it will appear in the final stage, together with the depreciation and maintenance charges. The figures represent a preliminary estimate, but they are very close to what the actual figures are likely to be when the storage field is in full operation.

Estimate of capital outlay and corresponding charges for the Beynes underground storage field in the final stage.

TABLE 2.

Estimate of capital outlay and corresponding charges for the Beynes underground storage field in the final stage

Item	Capital outlay		Corresponding charges		Total charges	
	(Mill. of Fr. frs.)	% of total	Depreciation and financial charges (Mill of Fr. frs.)	Annual maintenance charges (Mill of Fr. frs.)	(Mill. of Fr. frs.)	% of total
Preliminary and geological research	350	6·7	27	—	27	5·4
Connecting pipe-line and junction	920	17·6	70	6	75	15·2
Wells—collecting system—completion	1,610	30·8	133	13	146	29·2
Station for recompression and special treatment of gas :						
1st instalment	900					
2nd instalment	980		160	16	176	35·2
of which for special treatment alone: 380 mill.						
	1,880	35·9				
Miscellaneous—road network—housing of staff	270	5·2	20	1	21	4·2
	5,030	96·2	410	36	446	89·2
Non-recoverable gas, 30 mill. m³ at 6·65%	200	3.8	6		6	1·2
Extra charges for total cushion gas (4.5%)	—		48		48	9·6
Grand Total	5,230	100·0	464	—	500	100·0

The equivalents in English money are capital cost £3.8 mill and charges £363,000.

TABLE 3

Estimated operating costs for the Beynes storage field on the basis of an annual storage and withdrawal of 150 mill. cu. m. (in millions of French francs)

	Fr. frs. per cu. m.	Mill. Fr. frs. for 150 mill. cu. m.	%
1. Variable costs			
Compression	0·65	97·5	13·2
Treatment	0·60	90	12·2
Well and field	0·15	22·5	3·0
Total	1·40	210	28·4
		Mill. Fr. frs.	%
2. Miscellaneous costs			
Depreciation and financial charges, central overhead costs, group overhead costs		464	62·7
Labour		30	4·0
Maintenance		36	4·9
Total		530	71·6
Grand total		740	100·0

This table clarifies a point which has often remained rather obscure in the minds of many: The relatively low charge for cushion gas, which should actually be divided into two elements, one irrecoverable and the other recoverable and representing merely a supply which is immobilised for a greater or lesser length of time. Under the conditions existing at Beynes, the whole represents no more than 4% of the capital invested and less than 11% of the financial charges and maintenance costs. The operating expenses when the storage field is working normally are expected to be distributed as shown in Table 3.

In normal circumstances, the operating expenses would therefore amount to 4.90 frs. per cu. m. of gas passing through the storage field; and of these expenses fixed costs would account for more than seven-tenths. The variable costs, given as 1.40 frs. per cu. m., may be compared with the cost of transmission, which amounts to some 3 frs. per cu. m. These amounts, incidentally, must not be added to the mean annual cost of the gas, but to the cost of the gas in summer, when it is normally much cheaper. The question also arises, as will be seen in the following chapter, whether the various costs shown in Table 3 should actually be charged to the storage field itself or to the whole gas system which it serves.

Gaz de France estimates

Gaz de France estimates that peak-load plants with a production capacity equivalent to the storage capacity of the Beynes reservoir would have cost at least four times as much, that is to say that their cost would have been more than 22,000 mill. francs, whereas the capital outlay for the Beynes reservoir will amount to some 5,000 mill. francs.

For the Lussagnet underground storage field the capital outlay for an effective capacity of 500 mill. cu. m. is 16.25 mill. U.S. dollars (£5.8 mill.) of which $8.5 mill. (£3 mill.) is for capital outlay proper and $7.75 mill. (£2.8 mill.) for the cushion gas (both recoverable and irrecoverable).

Per effective cu. m., the capital outlay amounts to 13.70 French francs, or U.S. $0.03.

The estimates for operating costs and financial charges have been based on a slightly different assumption—that 400 mill. cu. m., and not 500 mill. cu. m., would be passed through the storage field per year.

Under such conditions the total operating costs work out at $2.294 mill. (£820,000) per year, of which $324,000 (£115,000) are variable costs including compression and gas treatment and the balance of $1.970 mill. (£705,000) is for depreciation and financial charges, overheads and maintenance, and labour.

Technical features

As has been pointed out, the saving represented by the storage field, in the case of Lussagnet, may be judged in particular by the extent to which it renders unnecessary the erection and use of reserve plant capacity for treatment at the production end. In the case of Lussagnet, the cost of installing underground storage facilities may be compared with that of building larger processing units. Figures for capital outlay of $16.25 mill. for storage compared with $36 mill. for reserve plant and for operating costs of $494,000 and $3.6 mill. respectively show how much more economical underground storage is in this particular case.

The physical and technical features of Rostoki reservoir have had a considerable bearing on the amount of capital outlay required and consequently on its general economy. The reservoir is an old field, quite well known, and the essential plant already existed. All that had to be done, therefore, was to build some quite inexpensive supplementary instalations and lay a few hundred metres of pipe-line. The cushion gas (12 mill. cu. m.) was provided by the gas remaining in the old field. The result is that the capital cost per cu. m. is only 1.4 grosz per cu. m. of effective capacity. The extremely low capital outlay is, therefore, (in zlotys), 120,000 for supplementary installations, 100,000 for pipe-lines and the gas cushion is valued at 6 mill.; a total of 6.22 mill. The operating cost is less than 1 grosz per cu. m. withdrawn.

Fluctuations in demand

Without endeavouring to draw general conclusions, it may be pointed out (a) that capital outlay is relatively high and that in consequence fixed costs are proportionately very large, amounting to 70 to 85% where formations are not old gas fields, and (b) that operating costs, on the other hand, are very low.

Generally speaking, it would seem that in all cases underground storage is a more economical means of coping with large fluctuations in demand than supplementary production units. However, the information supplied varies to such an extent that, even taking into account the different geological or geographical conditions which might in some degree explain the variations, the question arises whether the calculations are really in all cases comparable. The economics of underground storage are still not well enough known to enable strict comparisons to be made at the present stage.

While it is certainly still too early to outline an economic theory of underground storage, and while one may even doubt whether it will ever be possible to reach that stage, it is nevertheless interesting to try and define the problems arising, such as, for example, the profitability of storage in particular circumstances. In other words, the question naturally arises whether the construction of an underground reservoir, in particular conditions of production and consumption, will be more or less economical than the use of other means of improving the flexibility of the gas industry. All the experts from the various countries are agreed on this essential point; that save in exceptional

circumstances, an underground storage reservoir can only be economical when it forms part of a large system involving the production and consumption of hundreds of mill. of cu. m. In the U.S.S.R., for example, a detailed theoretical study has been carried out from which it appears that underground storage only becomes economical above a fairly high volume.

From the point of view of the technical means of meeting peak demand, no comparison can therefore be made between underground reservoirs and even the largest conventional gasholders. The capacity of gasholders and the storage capacity of underground reservoirs are of an absolutely different order of magnitude. The comparison will therefore have to be made either with enlargement of transmission systems—for example, the doubling of these systems, as in Roumania—or with the introduction and use of supplementary production units with a substantial capacity. On the demand side, measures of a commercial nature, such as the imposition of certain restrictions on consumers, might also be considered. They will very often, as the American example shows, be used simultaneously with underground storage.

Economic study

This comparison with supplementary production units has already been made very concisely, and it showed that in favourable circumstances capital outlay on underground storage could be from 300 to 400% more economical than capital outlay on supplementary production units. But the complexity of such comparisons and the care with which they must be carried out should once again be stressed. The economic study of an underground reservoir goes a long way beyond the mere technical profitability to which attention is usually confined when a production unit is installed. While it is certainly necessary to take account of the existing situation in considering the cost of such units, an attempt must also be made to estimate what the situation will be in the future. For example, the cost of liquefied petroleum gases such as propane and butane is subject to fairly rapid fluctuations. This is particularly true at a time when the development of natural gas is beginning to revolutionise the European gas economy.

Furthermore, depreciation, financial charges on the capital invested, general costs and labour for ordinary maintenance as a whole should, under normal accounting practice, be charged to the gas passing through the reservoir. While this method may be acceptable from the accounting point of view, however, it is not necessarily sound from the economic point of view. Indeed, more careful consideration of the situation in the Paris region will show that the existence of the storage field at Beynes considerably reduces the production and maintenance costs of the existing gasworks, in particular by substantially improving their load factor. Moreover, the use of an underground storage field may make it unnecessary to keep bringing back into service plant which is obsolete and fully written off. The savings under this head alone are estimated by Gaz de France at 450 mill. francs (£328,000) for the Paris region. In accounting practice, these savings, though due to the underground storage field, are mostly credited to production. Actually it would no doubt be more logical to charge the variable costs to the gas passing through the storage field, but to spread the fixed costs over the whole of the gas distributed within the consumption area concerned.

It must also be added that the gas stored in the underground reservoir is gas produced during the periods of least demand (in summer)—which it would have been difficult, if not impossible, to dispose of otherwise. It is therefore a gas at a very advantageous marginal cost, and this enhances the true economic value of underground storage. The profitability of an underground storage field, however, is a complex notion which goes largely beyond ordinary conceptions of cost.

In any event, the profitability of underground reservoirs is affected by numerous factors, some of which can be calculated while others are, strictly speaking, imponderable, though this does not reduce their importance.

These factors are as follows:

1. The characteristics of consumption—and in some cases of production—its growth potential, its present structure and foreseeable changes.

2. The physical and technical characteristics of the formation, which largely determine the capital outlay required, operating conditions and, consequently, operating costs.

3. The geographical situation of the reservoir.

4. The importance of the reservoir from the point of view of security of supply.

As has just been pointed out, underground storage is hardly conceivable economically unless a large volume of gas is consumed or produced. It goes without saying, moreover, that the structure of consumption, its distribution among uses of a more or less markedly seasonal nature, and the growth potential of certain sectors, particularly heating, play an essential part, the importance of which needs no emphasis, in deciding whether or not to build an underground storage field. What should be noted here is that, by making tariff adjustments possible, the provision of an underground storage field will itself in many cases encourage the growth of certain uses for which gas is particularly well suited and which had often to be discouraged in the past on account of their harmful effect on modulation.

Physical characteristics

It is the physical and technical characteristics of the formation which determine the economy of the reservoir, once the preliminary conditions relating to consumption have been satisfied. In deciding whether or not to operate a storage field, the physical conditions are obviously those which will largely determine the capital outlay required. They may influence the cost per cu. m. of capacity, not only through the capital outlay but because there may be substantial differences between the systems of operation they require.

Underground storage is obviously a device which lends itself to mainly seasonal operation. Nevertheless, sound as that principle may be, consideration may also be given to the possibility of using the reservoir, if conditions permit, for covering peaks of lesser amplitude. In some cases the hourly withdrawal capacity may amount to as much as 1.5% of the total capacity of the reservoir, while in others it falls short of .4%. It will obviously be more economical in the first case than in the second to make use of the reservoir for covering weekly peaks, for example, provided the input capacity is equally favourable. If the permeability is good, supplementary wells may be sunk so as to give the reservoir greater flexibility. This will increase capital outlay but enable more gas to be passed through, thus reducing the cost per cu. m.

During periods of heavy demand an underground storage field possessing the optimum characteristics in this respect will in fact merely act as a seasonal regulator; at times when the system is working at maximum load, the whole capacity of the underground reservoir will be used for satisfying the extra demand. As this extra demand decreases, however, the storage field may begin to contri-

bute towards covering daily peaks, thus acting as a reserve available for distribution. The storage field may also be used in this way when it is being filled in summer and during the autumn until the very cold weather starts. The contribution which may be made by underground storage towards satisfying non-seasonal peak demands nevertheless needs to be defined a little more precisely. On this subject, opinion seems to be somewhat divided, and it is difficult to draw a clear-cut conclusion.

It is immediately obvious that, to cover an additional peak demand of any duration, there must be a large number of intake and sendout shafts, so that the reservoir can be brought into use as quickly as possible and should have the maximum filling facilities. On the basis of this essential consideration, the East German experts arrive at the following conclusions: 'In the case, for example, of a reservoir with a utilisable capacity of 100 mill. cu. m., the distribution capacity should never be less than 100,000 cu. m. per hour, and should if possible be 150,000 or 200,000 cu. m. per hour. The utilisation period for the distribution capacity, in relation to the utilisable capacity of the reservoir, should therefore be at the most 1,000 hours. The further this number is reduced, the more the value of the reservoir as an installation for providing peak-demand gas will increase.'

Optimum profitability

This point is disputed, however. Some experts consider that this opinion is tenable only if the value of using an underground storage reservoir at extreme peak periods is demonstrated by a technical and economic study showing, among other things, the classified sendout curve, the classified prices of gases available from different sources and the potential output of a well. There are other conditions which determine that the optimum profitability of an underground storage reservoir corresponds, as in the case of the Beynes reservoir, to a utilisation level situated between the basic and peak production capacities. Furthermore, owing to the nature of the storage stratum, and particularly its heterogeneousness, it may be inadvisable to reverse the flow of gas in the underground storage reservoir quickly, though some experts consider that there is no objection to such a reversal of flow, provided the physical characteristics of the reservoir are suitable. This controversy itself shows to what extent the physical characteristics of the field will influence its operation, for the dispute arises mainly from the particular features of different reservoirs.

The location of the underground reservoir affects the cost of the gas delivered to the distribution centre mainly through the capital outlay, or, to put it another way, by affecting the amount of the financial charges per calorie in relation to the volume distributed. Thus, under American conditions, the cost of the gas distributed is, in the most favourable case—that of a storage field situated near the consumption centre—35% lower than when there is no storage field and 23% lower than when the storage field is half-way between the producing field and the market. Theoretical studies carried out in the U.S.S.R. lead to fairly similar conclusions.

It is obvious that the American analogy cannot provide the basis for an economic law, or have any general validity, for it applies only to a very long lincat transmission system, though transmission systems in the United States, and perhaps also potentially in the U.S.S.R. are most often of this kind. The conclusions reached would be very different in the case of a highly ramified network serving several comparable consumption areas within relatively short distances of each other. In such cases it might very well be economically more advantageous to have an intermediate reservoir situated somewhere near the barycentre of the consumption areas.

The main value of such an example is to emphasise the fact that an underground reservoir has a big bearing on the cost of transmission between the centre where the gas is produced or extracted and the consumption centre. Thus, for instance, in France, taking the example of a single pipe-line linking a natural gas field with a large and very concentrated consumption area, with an underground reservoir either at the beginning or at the end of the pipeline, an estimate has been made of the amount by which the cost of transmission per cu.m. would be greater if the reservoir were at the beginning of the pipeline than if it were at the end. For a modulation—defined as the ratio between the mean and maximum sendouts—of 80%, and assuming the length of the pipe-line to be 800 km. (496 miles) and the mean daily sendout 8 mill. cu.m., the cost of transmission would be about 15% higher if the reservoir was at the production end than if it was at the consumption end of the pipe-line. If the modulation was 70%, the cost would be about 30% greater. This difference is due to the fact that the size of the pipe-line must be much greater if it is to carry the volumes of gas needed to satisfy the maximum demand.

There would at first sight appear to be little point therefore in building an underground reservoir near the production centre, i.e., at the start of the pipe-line. This conclusion does not apply, however, when the fixed costs for production and treatment of the gas are very high, and the example of Lussagnet is very characteristic in this respect. In this case, the underground reservoir enables the production plant to be operated at a regular load factor. It may render unnecessary the construction of expensive supplementary plant.

The value to be attached to security of supply in long distance natural gas transmission systems is still generally unknown in Europe because there are as yet no statistics relating to transmission breakdowns and consequently to their economic effects. Industrial consumers in particular must in any case have a guarantee from the producer that they will be supplied with absolute regularity and constancy. It is this requirement which underground storage very largely satisfies and it would be wrong to conclude, merely because this element cannot be expressed in figures, that it should not enter into account. From the point of view of security of supply, an underground reservoir installed in the neighbourhood of a consumption centre is more valuable than a reservoir situated near the production wells because, while it plays a comparable part so far as security of production is concerned, it is able to make a much greater contribution to security of transmission.

To conclude this rapid review of the economic problems of underground storage, it is possible, while remembering the real difficulty of making any generalisation, to distinguish certain features common to all underground reservoirs:

1. The profitability of an underground storage reservoir must be judged in relation to a whole system rather than within the narrow and artificial limits of technical accounting. It may also vary very appreciably according to the structure of consumption and its growth potential.

2. To be economical, an underground reservoir must form part of a large system.

3. Geographical situation has a very great bearing on the economy of the reservoir.

4. Security of supply is an important factor, the economic implications of which are difficult to express in numerical form.

GAS JOURNAL January 27, 1960

From a paper to the London and Southern Section, I.G.E.

The influence of rotation frequency on oxide purifier performance

By R. J. S. THOMPSON,

W. C. HOLMES & CO. LTD.

THIS paper will deal mainly with oxide purification in static beds, which remains the principal method of purifying manufactured gas in this country despite the very considerable effort which has been put into the development of alternative systems.

The basic reaction involved is that between ferric oxide and hydrogen sulphide, which results in the production of water, iron sulphide and heat. It is well known that the iron oxide must be moist and that all varieties of ferric oxide are not suitable.

Manufactured gases usually contain oxygen and this reacts with the ferric sulphide produced in the sulphiding reactions to reform the ferric oxide and release elemental sulphur with the production of more heat. Advantage is taken of this to revivify the ferric sulphide *in situ* by the addition of air to the gas in sufficient quantity to supply the oxygen required to convert all the hydrogen sulphide to sulphur. In practice the amount of oxygen required is usually the correct equivalent plus 0.5 to 8% surplus.

The chemical reactions involved are most simply expressed by the equations:—

$\frac{1}{3}\ Fe_2O_3 + H_2S = \frac{1}{3}\ Fe_2S_3 + H_2O$ (vapour) + 11.68 Kcal. per gram. mol. H_2S.

$\frac{1}{3}\ Fe_2S_3 + \frac{1}{2}O_2 = \frac{1}{3}\ Fe_2O_3 + S + 42.62$ Kcal. per gram. mol. H_2S.

If these are added together there results the overall equation:—

$H_2S + \frac{1}{2}O_2 = S + H_2O + 54.30$ Kcal. per gram. mol. H_2S.

If the water vapour is condensed a further 10.76 Kcal. per gram. mol. H_2S is released. The heat release may be expressed more conveniently in English units as shown in Table 1.

TABLE 1

	B.t.u. per grain H_2S
Sulphiding	·087
Oxidising .. .. (water as vapour)	·326
Total reaction .. .. (water as vapour)	·413
If water is condensed add	·081
Total reaction .. .. (water as liquid)	·494

Under normal circumstances of equilibrium operation an absorbing purifier will be operating under evaporative conditions due to the heat developed. Of the total heat, about one-fifth is due to the sulphiding operation and four-fifths are due to oxidising if this is complete. A further amount of heat is stored in the water vapour, not condensed in the purifying mass. This is about equal to the heat produced by the sulphiding reaction itself.

Let us consider what is happening in an active purifier in first taker position when it has reached equilibrium, which will be after several hours in that position. The oxide will be moist due to the moisture with which it was charged to the purifier. The temperature will have ceased to rise in the oxide mass, and the gas will be leaving the bed at a uniform temperature. There will be

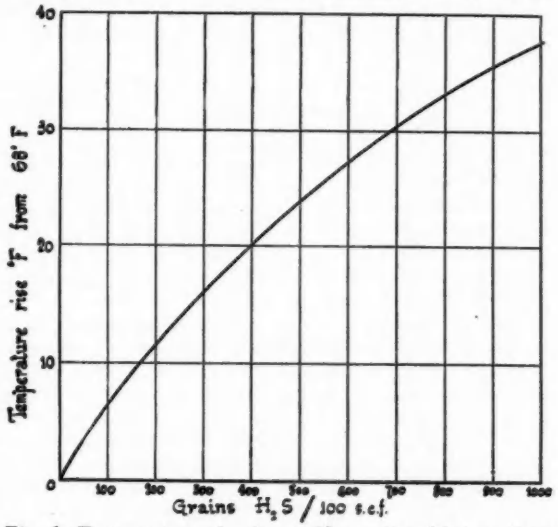

Fig. 1. Temperature rise in purifiers. Equilibrium figure assuming no heat loss, and gas leaving oxide saturated with moisture.

no heat lost from the body of the oxide bed for practical purposes, except that carried away by the gas. Assume:—

1. The gas reaches the oxide at 20°C. (68°F.).
2. The hydrogen sulphide absorbed is completely oxidised.
3. The gas leaves the bed saturated with moisture.
4. There are no heat losses from the bed except to the gas.
5. The purifier has been on stream long enough for the oxide bed and the gas to have reached equilibrium, i.e., there is no further temperature rise.

The temperature rise which can be expected in a purifier operating under these conditions is shown in Fig. 1. It will be seen for example, that gas containing 700 grains of hydrogen sulphide per 100 cu. ft. will produce an ultimate temperature rise of about 30°F. This then represents the maximum temperature rise in a set of purifiers, assuming no heat loss.

This point should be at the outlet of the purifiers, but in a normal set operating with first taker air admission the maximum temperature will usually be found at the

outlet of the second taker, due to the effect of heat lost to surroundings.

It is interesting to try and calculate how long it will take a set of purifiers to reach equilibrium conditions, and more particularly how long it will take a purifier newly swung into first taker position to reach equilibrium. To make this calculation accurately is very tedious, if not impossible. An approximate idea can be obtained fairly readily, however, if a number of assumptions are made. A calculation of this kind is useful as it can give an approximate idea of the time involved, and this is all that is needed.

If we consider a charge of new oxide weighing 51 lb. per cu.ft., made up of 34 lb. of oxide and 17 lb. of water, it will have a water equivalent of 23.8 lb. per cu.ft., assuming that the oxide itself has a specific heat of .2. If gas is passed through this at the rate of 40 cu.ft. per hour per ft. of oxide, equivalent to a contact time of 90 seconds, there will be a further water equivalent of .8 lb. approximately, due to the gas making a total water equivalent of the materials equal to about 24.6 lb.

The heat produced per hour from 40 cu.ft. of gas containing 700 grains of hydrogen sulphide per 100 cu.ft. is 138 B.t.u. under complete oxidising conditions. This also assumes that the whole of the water produced in a reaction is condensed.

From these data is will be seen that the rate of temperature rise at the beginning of a period in first taker position is 5.6°F. per hour. The maximum temperature rise for gas containing 700 grains of hydrogen sulphide per 100 cu. ft. is 30°F. Were the initial rate of temperature rise to be maintained, it follows that maximum temperature would be reached in about 5½ hours. In practice the time taken would be longer than this because the heat content of the gas per degree Fahrenheit increase in temperature increases as the temperature rises, and also because condensing conditions are not maintained throughout the whole period. This is offset by the temperature loss to the surroundings, so that the period of 5½ hours can be taken as of the correct order.

A more interesting temperature to examine, which can be calculated more easily without great loss of accuracy, is that at which the water produced in the reaction is equal to that lost in the gas leaving the oxide, assuming this is saturated.

Basis of calculations

Considering again a purifier absorbing and oxidising 700 grains of hydrogen sulphide per 100 cu.ft. of gas, and starting from 68°F., it can be shown that the gas will need to be saturated at a temperature of 79.4°F. to carry away the moisture produced in the complete sulphiding and oxidising reaction. This represents a rise of 11.4°F. Assuming a temperature rise of 5.6°F. per hour as calculated earlier, this means that this particular temperature will be reached in about two hours.

The above calculations were based on fresh oxide containing about 33% by weight of water on the wet basis. If the calculations are now made for a more average oxide made up of 30 lb. of oxide, 7 lb. of sulphur and 7 lb. of water per cu.ft., it will be found that the temperature rise during condensing conditions is 9°F. per hour, so that the point when the gas is carrying away the moisture produced in the reaction would be reached in under 1¼ hours. At the same time the maximum temperature rise would be reached in a little over four hours.

During the period between the time when a purifier is swung into first taker position, and the time when the moisture produced in the reaction is exactly balanced by the moisture being carried away by the gas, some of the moisture produced in the reaction will have been deposited in the oxide and some of it will have been lost with the gas. At the end of this period, therefore, the oxide will contain more water than when it was initially swung into first taker position. If the purifier is maintained in first taker position, more moisture will now be evaporated into the gas than is being produced by the reaction, and after a further period of time a point will be reached when the oxide has returned to its original moisture content.

An accurate calculation of the time required to evaporate the moisture deposited in the oxide during the period when it was picking up moisture is difficult. It is reasonable to assume that half the moisture produced during this period was deposited on the oxide.

It, therefore, follows that if the initial period during which moisture was being deposited in the oxide is two hours, as in the first calculation above, the time taken to evaporate the moisture deposited during this period will be one hour or less during the subsequent evaporating period. For the second calculation above when water was being deposited in the oxide for 1¼ hours, the period required to evaporate it will be half an hour.

Although these calculations are very approximate, they give some indication as to the rate of rotation which should be adopted if moisture is to be retained satisfactorily in the oxide. These calculations indicate that this period should be between one and three hours for normal coal gas and normal oxide.

Drying-out times

It is interesting to try and calculate the length of time that it would take to dry out a purifier completely. In this connection it should be realised that in a set of six purifiers, for example, any one charge of oxide purifies completely one sixth of the gas which has passed through it between charging and discharging. If, for example, in a set of six purifiers, each charge is changed after 60 mill. cu.ft. of gas have passed through it, then it follows that any one charge completely purifies 10 mill. cu.ft. of gas. The calculation can, therefore, be made on the assumption that the purifier remains in first taker position one sixth of the time between successive rechargings of oxide, and that it purifies all the gas completely under oxidising conditions while in that position. On this basis it can be shown that 1 cu.ft. of oxide charged with 35% moisture and fed with gas at 700 grains of hydrogen sulphide per 100 cu.ft., will lose the whole of its moisture when 5,500 cu.ft. of gas have passed through it, this gas being completely purified and oxidised. If this oxide were in a tower purifier containing 300 tons of oxide and being one of a set of six towers, this would mean that it would pass 43.5 mill. cu.ft. of gas between charging and drying out completely. This corresponds to 14% of sulphur on the dry basis on the oxide removed from the tower, or 16.1% sulphur on the original dry oxide.

The calculation is only very approximately correct, since the specific heat of the oxide is changing continually during the drying out period. This can be compared with practical results.

It is quite common for towers of this size to be changed after passing upwards of 100 mill. cu.ft. of gas. The moisture will have been reduced to 6/8% under daily rotation conditions and steaming, and the sulphur will have increased to 25% on the dry basis or about 33% on the original oxide.

It must be emphasised that the above calculations have been made for a particular set of conditions and are approximate only. They are intended merely to give a

picture of the conditions which exist when a purifier is swung into the first position after a considerable time has elapsed since it was last in that position, say, 24 hours or more.

These calculations indicate that for the conditions specified, moisture ceases to be deposited in the oxide after a period of one to two hours, and that any moisture deposited in the oxide during this period will have been evaporated after a further half to one hour. Therafter, so long as the purifier remains in the first taker position, it will lose moisture. Unless something is done to retain the moisture, the whole of it will have been lost by the time the oxide picks up 14% sulphur on the dry basis, or 16% on the original oxide. These and similar calculations led to the idea that a purifier, operating under the conditions for which these calculations were made, namely, treating gas containing 700 grains of hydrogen sulphide per 100 cu.ft., and being supplied to the set of purifiers around 70°F., should be swung out of the first taker position within a few hours of having taken up that position. The ideal time would be after two to three hours.

Frequency of rotation

If similar calculations are made for other concentrations of hydrogen sulphide, it will be found that for higher concentrations the frequency of rotation should be greater, and for lower concentrations less.

In the upward direction of frequency there is clearly a limit to what is practical and desirable. In normal purifier sets the gas remains in the purifiers for about 15 minutes, more or less, according to the design of purifier and contact time allowed. In a set of purifiers in which the contact time is 600 seconds, for example, the gas is in the oxide for 10 minutes, and to this must be added the time occupied in the dead space in the purifiers. Assuming that swinging can be done instantaneously, it follows that purifiers should not be swung at less than the interval taken for the gas to pass through the complete set of purifiers. The minimum period would, therefore, seem to be of the order of 15 to 20 minutes. To this must be added the time taken to swing the purifiers.

In many installations with water valves, not specially arranged for quick changing, the time of rotation may be as much as three quarters of an hour. This can be reduced very considerably if proper arrangements are made and should not exceed, say, 20 minutes.

Many installations with mechanical valves, hand-operated, can be swung in ten to 15 minutes, and mechanised installations with mechanical valves can be swung in no more than five minutes. With automatic operation this could be reduced to two or three minutes quite easily. With a properly-designed installation, therefore, treating high sulphur gas, it should be quite possible to swing the purifiers every 15 minutes if required.

Author's experience

So far we have only dealt with what may be claimed to be academic calculations. I would now like to draw your attention to the graph which was reproduced in the Gas Research Board's Reports, Nos. 43 and 52. The curve will be found on p. 385 of Vol. 98, and also on p. 336 of Vol. 99 of the transactions of the Institution of Gas Engineers.

The authors of these reports, which are among the most useful which have yet been published on the subject of oxide purification, showed that a particular oxide when sulphided and oxidised alternatively, can maintain almost 100% extraction efficiency for considerable periods, and that a sulphur loading of over 60% on the dry basis could be obtained. In their experiments the authors passed gas containing hydrogen sulphide and free from oxygen through the oxide until no more sulphur was taken up. There was an initial period of nearly 100% activity followed by a decline to nil. On revivifying, the oxide recovered 100% efficiency again for a period, declining again to nil. This return to 100% efficiency after sulphiding and oxidising was obtained seven times, at which point the oxide contained about 63% of sulphur, and the experiments were discontinued.

The author has not had the opportunity of repeating these experiments, but he suggests that if they were repeated and the sulphiding were stopped as soon as the efficiency began to fall, it would be possible to maintain 100% efficiency in the oxide almost indefinitely, and certainly up to the limits to which the experiments were carried, namely, to a sulphur saturation of 63% on the dry basis.

The point in referring to these experiments here is to relate them to the proposals on the rapid rotation of purifiers for the purpose of retention of moisture and of maintaining the purifiers in an active condition.

It is the author's belief from the indications of the calculations given above, coupled with the results obtained by the authors of the two reports referred to, that by rotating purifiers sufficiently rapidly and adopting second taker air admission it should be possible to maintain the first taker at 100% absorption efficiency throughout its life, and until it has absorbed its full quota of sulphur.

It will be interesting now to consider the operation of some actual purifiers.

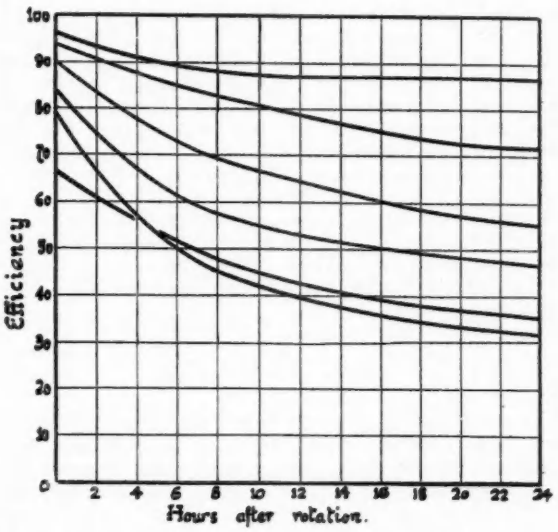

Fig. 2. Efficiency-time graphs; 24-hour rotation. First taker air admission.

Considerations such as the above led the author and some others to follow closely the behaviour of purifiers under actual operating conditions. Fig. 2 is reproduced from I.G.E. Communication No. 535 and shows the efficiency of removal of hydrogen sulphide of the individual purifiers of a set of six in the first taker position with first taker air admission and 24 hour rotation.

The significant fact is that in nearly every case the efficiency of the purifiers was high immediately after swinging, and thereafter fell away rapidly. In a recently charged box the fall from the initial efficiency naturally was smaller, but in some of the older charges the efficiency had fallen to 30 to 40% after 24 hours from an initial 80-90%.

A very large number of such curves is now available, not only from these particular sets of purifiers, but from many others and they follow the same pattern. A large number of examples are now known in which the efficiency of a purifier recently swung into the first taker position remains reasonably constant for an hour or two before falling away, as shown in the figure reproduced here.

The particular purifiers from which the data for Fig. 2 were taken were carefully watched for several weeks and the general pattern of behaviour was firmly established. It was decided that the information obtained on 24-hour rotation justified the idea that more frequent rotation would be beneficial and the towers were rotated every eight hours for several months. Subsequently the period was reduced to six hours and then to four hours. The full story of these experiments can be read in I.G.E. Communication No. 535 referred to above, but the general result was that the anticipations were justified and the general efficiency of the towers was raised substantially, moisture retention was improved, the number of clean towers for a given load was increased, and it was found possible to increase very substantially the throughput of the towers above the design figure.

The most notable results of rapid rotation have been obtained with tower purifiers and tower box purifiers, and several installations are now operating with rotation after four, six and eight hours.

It is also known that a number of sets of normal boxes are also being rotated more frequently than 24 hours, and that beneficial results have been obtained.

Restriction of purification

Very shortly a set of new purifiers with automatic valve operation will be commissioned. It is expected that the inlet hydrogen sulphide may be as high as 1,000 grains per 100 cu.ft., and the period of rotation has been set at 2 hours. The time taken for swinging the purifiers will be 1½ minutes, and could be reduced further. The plant contains several other interesting features and the results of its operation are looked forward to with great interest.

It will be useful at this point to consider what happens inside a layer of oxide subject to rapid rotation.

Experiments were carried out under the author's direction with a laboratory set of purifiers in which the gas was rotated every three minutes. It was found that purification was largely restricted to the lower layers of the oxide, through which the gas was flowing in an upward direction, until the bottom layer was spent. The spent layer of oxide slowly moved up through the bed until the whole bed was spent. At the same time the lower layers of oxide were slowly dehydrated and the moisture transferred to the upper layers until these were equally dehydrated when they in turn came to carry out the purification. When the bottom quarter of the oxide was completely spent, the average moisture content of the whole bed was actually higher than that with which the oxide was charged.

In the discussion on I.G.E. Communication No. 535, Mr. B. Thorpe reported data from a practical installation which confirmed that a similar phenomenon occurs in tower purifiers worked under rapid rotation conditions.

These observations indicate that moisture retention under rapid rotation conditions should be improved if the flow of gas through the oxide is reversed from time to time. The moisture deposited in the upper layers of the oxide during upward flow could then be driven down into the lower layers.

It is probably not necessary that the direction of flow should be reversed every time the purifiers are rotated. A convenient arrangement might be to rotate the purifiers every two to four hours and reverse the flow once every few days.

The standard connections for a purifier are set out in Fig. 3(a). Only one purifier is shown as the arrangement is repeated for each purifier, the connections from the last taker connecting up to those for the first taker. This arrangement is satisfactory for standard purifiers which are rotated infrequently, and where rotation can be stopped long enough for a purifier to be emptied and recharged. This automatically necessitates large purifiers with ample charges.

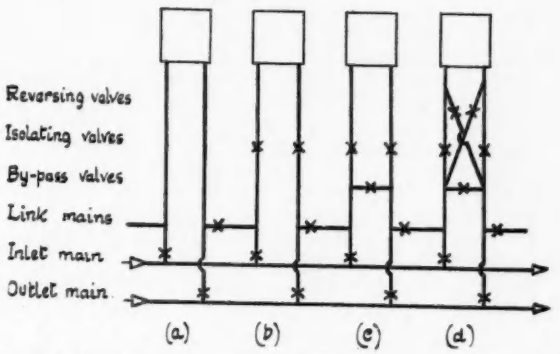

Fig. 3. Purifier connections for backward rotation. (a) standard, three valves per purifier; (b) extra isolating valves for safe emptying, five valves per purifier; (c) extra by-pass valves enable boxes to be rotated when one is being emptied, six valves per purifier; (d) reversing and by-passing connections, eight valves per purifier.

If loading and rotation frequency are to be increased, it may be necessary to arrange for the remaining purifiers to be rotated while one is off for discharging.

One way to do this is to add a byepass to each purifier as shown in Fig 3(c). Some undertakings already insist on this arrangement, at least to the extent of the two isolating valves for each purifier, as shown in Fig 3(b). Often these two valves are water valves. If this byepass is added the main valves can be rotated in the normal manner, irrespective of whether a purifier is off for discharging. This would enable an automatic mechanism for swinging the purifiers to continue uninterrupted at all times. This arrangement requires six valves for each purifier, three of which could be manually operated when required, and three mechanically or automatically operated.

By the addition of two further valves to each purifier, as shown in Fig. 3(d), the direction of gas flow in any purifier can be reversed. These valves could be manually operated as required.

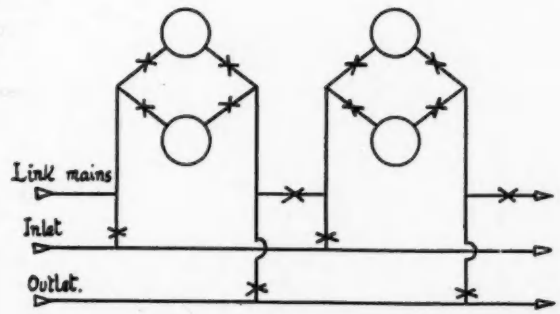

Fig. 4. Arrangement for rotation while a purifier is being recharged.

Another way of allowing rotation to be continued when one purifier is off for discharging is shown in Fig. 4. In this case each purifier is made up of two units either of which can be isolated independently. The main valves are rotated as frequently as is required at all times, and individual units are taken out of circuit without interrupting the rotation. The system has the advantage that the amount of oxide out of circuit during discharging is only half the normal quantity.

Mechanical and automatic operation of gas valves is commonplace, and is standard practice on water gas and oil gas sets. For purifier operation conditions are much less stringent and operating frequency is less. There should, therefore, be no fear of applying mechanical and automatic operation to purifiers.

Many different systems are available. For non-automatic local operation an air motor offers a simple solution. Purifiers using air motor operated valves, locally controlled, have been in operation many years with complete satisfaction.

A more complete system is mechanical operation controlled from a panel. For this purpose hydraulic or electric systems are recommended. Electrical systems have certain disadvantages on gas works and are probably more costly.

Once a panel operated system is considered, it is a small step to make it completely automatic, since the timing gear required is a relatively inexpensive item.

It should be noted that there is no difficulty in mechanising water valves. Quite simple systems for this have been worked out.

It would be far too difficult in this paper to go into the details of automatic and mechanical systems, but several systems have been worked out and are available.

A considerable amount of work has been done on so-called dynamic purification, which has come to mean continuous movement of the iron oxide through which the gas is flowing. Pilot plants have been built and operated on this system, and it has been shown that high rates of purification can be achieved successfully.

The principle difficulties which have been experienced are due in the first place to the nature of the iron oxide used and, secondly, to the difficulty of introducing a solid material to and removing it from a vessel under pressure.

Moist iron oxide is a material which does not flow readily. The problem of making the material flow countercurrent to the gas has been solved satisfactorily at high rates of gas flow approaching those at which the material becomes fluidised. The high rate of flow of the gas helps to keep the purifying material in a condition under which it will flow and which allows it to be removed from the bed. The difficulties begin when the oxide is collected together again in a mass which must then be removed from the purifying vessel without loss of gas. The same problems arise again when the material must be reintroduced into the gas stream.

Dynamic purification

The technique of rapid rotation of purifiers containing static beds can be likened to dynamic purificaton. The difference is that with rapid rotation on static beds the gas is switched round instead of the oxide. A set of six purifiers, for example, in which rapid rotation is being practised, is similar to a dynamic purifier in which the top layer of oxide amounting to one sixth of the bulk, is being repeatedly removed and placed at the bottom of the purifier. The effect of dynamic purification has, therefore, been largely achieved without the necessity of moving the oxide. Naturally, not all the advantages of dynamic purification are obtained by rapid rotation, since there is no doubt a real advantage in keeping the oxide in the purifying bed in a moving condition.

In the dynamic purifier also, the oxide removed from the container can be reconditioned before it is returned. In rapid rotation of static beds this can be simulated to some extent by the use of inter-coolers between purifiers and reversal of flow.

One of the advantages of a dynamic purifier is that the average moisture content of the oxide in use can be kept very much lower owing to the fact that the oxide is removed very frequently from the circuit and reconditioned before returning to it.

Owing to the retention of moisture which is possible with the rapid rotation of static purifiers, it should be possible to charge the oxide to the purifiers with very much less moisture than is the present practice, and this is being tried at some works on a practical scale. The indications are that it should be possible to charge the oxide to the purifiers with 15 to 20% moisture instead of up to 35% which has been the practice previously.

By comparison with purifying materials used on the Continent, English oxide is relatively inactive. To a large extent this can be attributed to the greater use made abroad of Lux and Lauta purifying materials, which are the residues from one process of the purification of bauxite for aluminium manufacture. One of the tests used on the Continent for determining the usefulness of a particular purifying material is the Ruhrgas test in which a stream of inert gas containing hydrogen sulphide is passed through a column of the purifying material under standard conditions. One of the characteristics of the oxide which is noted in the test is the time which elapses before hydrogen sulphide makes its appearance in the exit gas.

With normal English commercial oxides which the writer has seen tested in this apparatus, the break through time is one hour or less. Prepared Continental oxides show a break through time of several hours, and the period may be as much as ten times that for English oxides.

This test only shows one characteristic of purifying material, but its particular significance is that Continental oxides are much better for removing the last traces of hydrogen sulphides from gas than English ones. This has been proved in large scale tests which have come to the notice of the author, in which complete charges of English oxide were used in a German installation of purifiers. Under the German methods of operating the English oxide failed to clean the gas after a very short time, much less than the corresponding German oxide.

German installation

An interesting point which emerged, however, was that the total take-up of sulphur by the English oxide before discharging was equal to or better than the German oxide.

These results are not surprising when it is remembered that purifiers operate under oxidising conditions. The total take-up of sulphur by a particular charge, therefore, is not entirely related to the amount of iron oxide in that charge, since the iron is reused many times over and, in fact, behaves fundamentally like a catalyst. The total amount of sulphur taken up, therefore, should relate to the number of times the iron oxide is re-oxidised rather than to its absolute quantity.

However, the effectiveness of a particular charge of iron oxide for removing the last traces of hydrogen sulphide may well be related to the absolute quantity of iron oxide in the charge, and this is the point in which Continental iron oxides tend to differ from commercial English oxides.

The author has had the opportunity of testing in the laboratory a commercial English oxide containing larger

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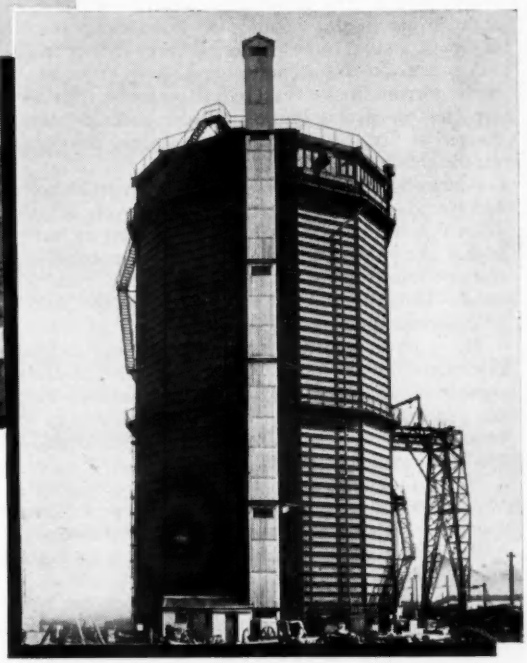

M.A.N. Waterless Gasholders of 2 mill. cu.ft. and ½ mill. cu.ft. capacity recently erected by us, for the storage of blast furnace and coke oven gas respectively. (Photographs by courtesy of the Stanton Ironworks Co. Ltd.)

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quantities of active iron oxide than is contained in the normal commercial oxide. The specially fortified iron oxide has a performance very similar to that of the German oxides in normal use. The price quoted for this specially fortified oxide was not greatly in excess of that of normal oxide, and the author suggests that there is a strong case for considering the use of more active oxide in normal purifiers.

It had been the custom generally to allow a small amount of ammonia to slip the ammonia washers for the express purpose of maintaining alkalinity in purifiers. It had been claimed from time to time by various authorities that inactive purifiers can be regenerated at least for short periods by temporarily increasing the ammonia supplied to that particular purifier when in the first taker position.

Recent evidence which the writer has collected from a number of works seems to indicate that purifiers operate equally well on quite small amounts of ammonia in the gas, say, 1 or 2 grains at the most, and that greater quantities of ammonia definitely tend to produce 'regeneration,' or 'throwing off.' This has been particularly noticeable in the recent hot summers.

Definite trend

There seems to be definite evidence accumulating that high temperatures and high ammonia concentrations in the gas tend to produce regeneration and reduce purifier efficiency. There seems to be a definite trend to operating purifiers with the minimum possible ammonia concentration in the inlet gas.

The traditional use for spent oxide is in sulphuric acid manufacture. The number of acid plants which can use spent oxide in this country is diminishing and disposal of spent oxide is becoming a very serious problem.

Some works are already dumping spent oxide, but this itself presents a problem. It is doubtful whether dumping can be carried out on a large scale in view of the danger of fire, which could have serious consequences in the neighbourhood.

One well known supplier of oxide for purification accepts spent oxide back for extraction and recovery of its sulphur content. An important condition imposed by this supplier is that the spent oxide shall contain a specified minimum cyanide content, the recovery of cyanide from the spent oxide being the factor which renders the recovery of sulphur economic.

The author considers that the time has arrived when the extraction of sulphur from the spent oxide must be considered seriously by the gas undertakings themselves. As a process this presents no serious difficulty and has been developed successfully on a large scale not only by the firm mentioned above, but abroad.

The author knows of plants abroad recovering at least 50,000 tons of sulphur per annum from spent oxide, corresponding to the treatment of at least 100,000 tons of spent oxide. Most of the sulphur recovered is of high purity and commands a ready market.

The solvent used almost universally is carbon bisulphide which readily dissolves sulphur at normal temperatures and offers the simplest and most direct method of recovery of sulphur from spent oxide in the pure or semi-pure form. The plant offers no difficulty in operation and can be made completely safe from all hazards.

Objection has been raised to the use of carbon bisulphide because it is inflammable, but this can be no serious objection to gasworks engineers accustomed to handling enormous quantities of inflammable gas, and the plant need be no more dangerous than benzole recovery and refining plants. It has the added advantage that its odour makes it readily detectable so that leaks, if they occur, can be attended to immediately.

Carbon bisulphide also has the advantage that it is much heavier than water. This has the advantage that water can be used for quenching fires and all vessels containing carbon bisulphide can be mounted over a shallow pond of water. Should any carbon bisulphide from any vessel find its way to ground level, it would immediately sink below the water in the pond and be rendered safe. The plants referred to on the Continent have operated many years without untoward incident.

The extracted oxide from the process retains a high activity and can be used again several times. This is an added attraction of the process. The extracted oxide must be rejected eventually because of changes in physical condition and because its iron content is gradually converted into inactive compounds such as cyanide and sulphate.

As with the iron oxide purification process itself, much of the cost of operating an extraction process is bound up with the handling of large quantities of materials.

Although the recovery of sulphur from spent oxide is uneconomic or marginal, its adoption may become necessary if the oxide process is to continue in use. In view of the large amount of pure sulphur which is now available, both from the American deposits and from refinery and natural gases, particularly the deposits at Lacq which will shortly be producing over 1 mill. tons of sulphur per annum, there seems to be little prospect of any improvement in the sale of spent oxide for acid manufacture. So far as the writer can see, the only prospect is the recovery of the sulphur from the spent oxide in a pure form which will avoid the necessity of dumping spent oxide on a large scale, even if this is permissible.

Effectiveness increased

The hydrogen cyanide content of the coal gas to be purified presents a problem which may in some cases be converted to an advantage. It has already been stated that the recovery of cyanide from spent oxide may render its treatment economic and this is actually practised.

However, there is no doubt that the cyanide removed from the gas in the purifiers removes active iron and decreases the effectiveness of the iron oxide for its proper purpose. Oxide purification as such would probably be improved if the hydrogen cyanide were removed before the purifiers. This is particularly the case if the spent oxide is to be treated for sulphur recovery and then used again.

There are several ways of removing the hydrogen cyanide from coal gas, and one method is to place a purifier containing iron oxide in the coal gas stream at the inlet to the ammonia washers. Such a purifier will remove almost the whole of the hydrogen cyanide and also the nitric oxide in the gas, provided that the oxygen content of the gas is not too high. The cyanide content of the oxide placed in this position can be worked up to 20 to 25% before discharging. This offers a simple way of protecting the oxide in the main purifiers from hydrogen cyanide, nitric oxide and possibly also from the so-called tar in oxide, which is known to be largely gumlike materials from the unsaturated hydrocarbons in the gas.

Pilot plant experiments on this process were carried out at the Hamburg gasworks many years ago with considerable success, but the author is not aware that they were implemented on a large scale.

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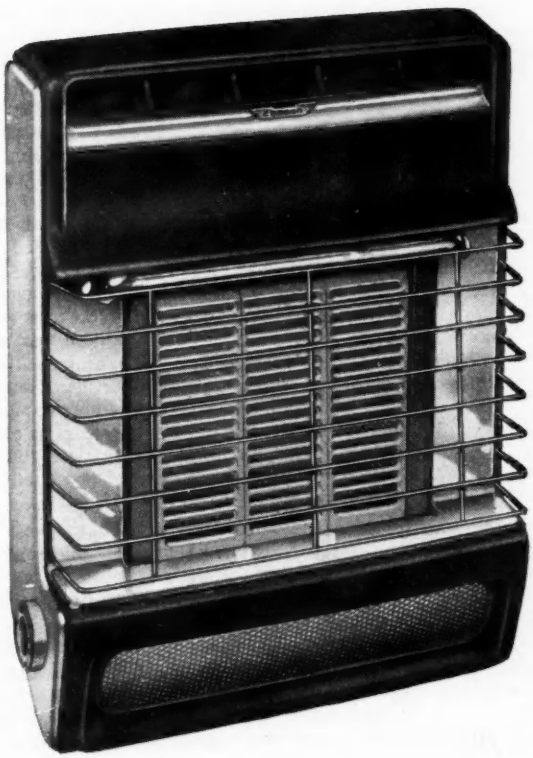

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hydrogen sulphide from manufactured gases in this country. Whatever new processes are introduced, and the introduction of alternative processes is quite likely, the oxide process remains with us and will do so for a very long time.

It is imperative, therefore, that it should be used as efficiently as possible, and the author suggests that future developments in oxide purification will be along the following lines:—

1. A substantial reduction in the size of purifiers made possible by rapid rotation.

2. Rotation of purifiers at much shorter intervals than has previously been the practice.

3. Complete mechanisation of the valve equipment with automatic operation.

4. Provision of arrangements of reversing gas flow in purifiers from time to time.

5. The introduction of cooling equipment between purifiers to dissipate the heat of reaction.

6. Complete mechanisation of emptying and filling purifiers, including mechanisation of the emptying of oxide containers in those purifiers where they are used.

7. Extraction of sulphur from spent oxide.

8. Use of oxide of greater activity.

9. Preliminary removal of hydrogen cyanide and nitric oxide from gas to improve the quality of the spent oxide and the sulphur recovered from it.

DISCUSSION

Mr. A. J. L. Gamper, S.E.G.B., opening the discussion, congratulated Mr. Thompson on a most interesting paper, which he thought, however, was largely a theoretical study and he was yet to be convinced that the advantages of rapid rotation outweighed its disadvantages.

Conditions, and particularly oxides, varied so much that comparisons of performance between works were most difficult. Because of the large mass of material composing the purifier and the big conducting areas, it took substantially longer in practice to establish stable conditions than the author's calculations would suggest.

The original set of tower purifiers at Wandsworth had been put to work in 1938 and had been fitted with reversing valves. In the early days a considerable amount of work had been done testing the sulphur and moisture content of the oxide discharged from different parts of the trays and also in determining the variation from tray to tray. These tests had been repeated for towers worked with upward flow conditions and compared with those for towers which had been subject to reversal of flow. The conclusions arrived at had been that reversal of flow did not improve performance and so reversing valves had been omitted from the second set of towers erected in 1948.

Gas engineers referred to purifying material as ' oxide ' as though it were a product specified to a British Standard, whereas the variations in oxide quality marketed in this country were quite incredible. The original Wandsworth instalation had gone to work with a 70:30 bog ore lux mixture which had been very active and had required an ammonia slip of only 2 grains per 100 cu.ft. During the war, the percentage of lux had had to be reduced, and bog ore had given way to burnt oxide until ultimately no bog ore had been used. These oxides had performed well with the ammonia slip raised to 8 grains per 100 cu.ft., but higher back pressures had been encountered. The present grade of oxide which had been in use since 1952 was also based on burnt oxide, re-activated, and included a lightening agent. There had been some hesitation in using this material because of the lower iron content but activity had been maintained and back pressures were normal.

Initially containing about 40% moisture, this material was worked up to a saleable sulphur content of over 50% in two foulings. Frequency of rotation was normally daily, but it was not unusual for a second fouling charge to be held as first taker for a considerably longer period. From April, 1957, to February, 1958, B set tower purifiers had been maintained at its rated capacity of 10 mill. cu.ft. of gas per day. The unit had been purifying mixed gas but for a three months' period it had worked on straight coal gas with an average H_2S content of 502 grains per 100 cu.ft. Daily rotation had been practiced. Two clean towers had been maintained at all times and the ammonia slip had been 8 grains per 100 cu.ft. The oxygen content at the inlet to the towers had been kept at .9% and no special attention had been required and an ample margin of safety had been maintained. He thought, however, that the surplus oxygen mentioned in the paper appeared excessive.

With a substantially higher H_2S content, it seemed that a more frequent rotation might be necessary, but it did appear that there might be some difficulty in working up a tower to an acceptable sulphur content in these circumstances. He would be interested, however, to hear more of the increased capacity claimed for more frequent rotation and to learn something of the economics of the proposed developments.

Mr. Thompson, replying, said that he confirmed what Mr. Gamper had said about the fitting of gas flow reversing valves, and there was nothing to be gained from them. He himself had commissioned the tower purifier plant at Wandsworth in 1938 so he was familiar with the conditions under which it worked. If the first taker was looked upon as a purifier and the second taker as an oxidiser, *i.e.*, with air admission at the second taker, then reversing valves were an advantage. He did not agree that the oxygen figure mentioned in the paper was excessive, in fact it was at the bottom end of the range. Calculating from conditions ruling at Wandsworth, he was sure that the excess oxygen in the gas being treated in the purifiers there was almost identical with the figures quoted. He thought that an increase in purifying capacity with crude gas containing 500 grains per 100 cu.ft. was feasible by more rapid rotation. With gas of 700 grains per 100 cu.ft. sulphur content, he said it would be difficult to keep three clean towers at 24-hour rotation, but quite easy at eight-hour rotation.

Mr. R. Bairstow N.T.G.B., Bow Common, congratulated Mr. Thompson for giving such a very lucid explanation of the greatly improved performance of tower and tower box purifiers when the frequency of rotation was increased. Referring to the Navy's popular phrase to describe a very desperate situation as 'We're up the Creek, less both paddles' he said it was true, that, until quite recently, most operators of tower purifiers had, at some time or another, found themselves in this unfortunate position, when trying to work the set at the designed throughput. However, if use was made of some of the recommendations given in the paper, they would quickly find that not only were both their paddles restored to them, but that they had also acquired a very powerful outboard motor to navigate them back to the main waterway.

At Bow Common, the tower box purifiers set consisted of five towers and it was designed to purify 4 mill. cu.ft. per day when worked as a 4-box set. Its performance had been so disappointing that it had to be worked with five boxes and swung every 24 hours. The throughput under these conditions had been only 3.3 mill. cu.ft. per day, the last two boxes had been clean and the monthly average efficiency of the first takers *one* hour after the swing had been 80%.

Recently the set had been swung every eight hours and the throughput had increased to 4.5 mill. cu.ft. per day, the last three boxes had been clean and the monthly average efficiency of the first takers *seven* hours after the swing was 85%. The sulphur content of the inlet gas had been 630 grains per 100 cu.ft.

The main difficulty associated with increasing the frequency of rotation of purifiers, he pointed out, was finding trained personnel to do the operation out of normal working hours. Dr. Haffner had once very aptly described the swinging of purifiers as being shrouded in Black Magic, so perhaps the method of training adopted at Bow Common might be of interest.

The valves on the set had been numbered from one to 22 to avoid any confusion over their description and these numbers had been stencilled on large round plates attached to the spokes of the valve operating wheels. The trainees had been given written instructions to open and close the necessary numbers in the correct sequence and the initial training had been supervised by the foreman as each shiftworker came on to day shift. During this training period the set had been swung at 8 a.m. and 4 p.m. and even with this slight increase in the frequency of rotation the performance of the set had improved. When the men were considered competent, 8-hourly swings had been introduced. The foreman swung the set at 8 a.m. and 4 p.m. and left written instructions for the midnight swing. As a safeguard against a dirty swing, a 1½-hour paper on the G.L.C. H_2S test was taken on the outlet of the next to last taker and provided the stain did not exceed 1 ppm., the shift superintendent gave permission for the swing to take place.

Frequency rotation

Referring to the various types of valves mentioned in the paper, Mr. Bairstow asked what were the most suitable types of valve recommended by the author for use with frequent rotation; was a mechanical valve to be preferred and what extra wear and tear was to be expected if these valves were being operated 12 times more frequently every 24 hours. The selection of the correct type of valve was of the utmost importance under these conditions, particularly if the set was the only one on the gas stream. He was particularly pleased to see in the paper that the author foresaw a reduction in the size of newly designed purifiers and that he had not fallen for the temptation of increasing both the size and throughput of future sets. It was clear that a decision should be reached as to the optimum size of a dry purification unit, so as to avoid considerable inconvenience in the event of a valve failure, and he suggested that each unit should be at least capable of purifying one half or preferably one third of the maximum gas on the stream. The most economical method, if the site allowed it, would be to erect the units in line so that one crane and one oxide handling plant could serve all units.

The author's reference to English oxide he found puzzling and asked for this point to be clarified. Would the author advocate the use in tower purifiers in this country of the more active oxides used in Germany.

Mr. Thompson. Here was further proof that rapid rotation did what was claimed for it. It was sometimes difficult to demonstrate it and to interpret the results, but there was much evidence to substantiate it coming from individual works. After all, Mr. Bairstow had deliberately overloaded his boxes and on adopting the increased rotation technique had suffered no ill results.

As regards a choice of valves, comparison with c.w.g. plants in which the valves were worked far more often—every five minutes in fact—showed that valves manufactured by his firm and fitted to these plants, worked satisfactorily for at least a year without undue maintenance. Such valves fitted to mechanically or automatically operated purifier installations should last much longer. Water valves could be opened rapidly if set out to do so. Automatically operated valves could be made to carry out their share of the swing operation in 15 seconds so the whole could be carried through in three minutes with ease.

Comparing 'English' and 'Continental' oxides, he said that abroad the oxide contained a good deal of Lux and a very active Lux/bog ore mixture was very satisfactory and needed only a small ammonia slip.

Mr. F. H. Cope, S.E.G.B. East Greenwich, said that the substance of the paper if established over a long period successfully could possibly rank as an advance in purification technique equal in importance to the introduction of revivification *in situ* and the controlled injection of air into second takers.

There was, however, a technical point which had, so far, proved rather difficult and which the author might like to elucidate.

The sense of both the present publication and I.G.E. Comm. 535 of which Mr. Thompson had also been a joint author, was that the aggregate rise in temperature over a set of purifiers was less and at the same time the evaporation loss was less with rapid rotation than with longer period rotation. Where then, he asked, did the heat of reaction go, all other things being equal?

He suggested that the question of moisture in the bed was of less significance than might be supposed and that the improved results arose from the limitation of the zone in which intense activity took place and of the time, so that the increments of sulphur were, with rapid rotation, only a fraction of what they were on slow swinging. By this means the hardening of the bed was greatly retarded and its texture remained soft and mobile, which would encourage perhaps migration of iron and penetration of the material by better diffusion of the gas. He had in mind some of his experiences at East Greenwich, where there were a unique collection of tower purifiers. One stream had five rotational towers and a catch tower, a second had six rotational towers only. Three streams had only four rotational towers and of these, the outer cylinders of two sets were lagged from top to bottom, the conductivity of the lagging being not greater than .2 B.t.u. per sq.ft. per hour per °F. Dry heaters were provided on all streams and provision was made for the introduction of direct steam if required.

Discharge findings

In the lagged towers charges which had been working well had been found on discharge to be so dry as to give rise to considerable dust. On the other hand the use of dried steam in bare towers had been shown to prevent the drying out of charges, which had accumulated 50% of sulphur on the dry basis but were too moist to be saleable. In such a condition the charges had shown no disposition at all to superior activity over other much drier charges.

He asked the author to elucidate more fully the meaning he attached to loading. Was he to understand that an installation could be made to treat the designed load continuously all through the year, when using rapid rotation, or was there still a seasonal fluctuation. Mr. Cope's whole experience in purification was set against seasonal demands and generally against plant which at peak load was heavily loaded.

He said it was not possible to push the high loads through the vessels unless back pressure was reduced by relaying the charges, nor was it possible to keep the necessary safety margin on clean gas unless the average

chemical activity of the purifying material was high. Under conditions of daily backward rotation purifying plant would deal successfully with the winter maximum loads but when this period was passed, the load factor of the plant was unavoidably depressed and it was then possible to cease the supply of new oxide, reduce the rate of handling and leave the charges to build up to a saleable sulphur content. In such a system, he asked whether there was much point in improving performance and thereby merely having to shut down a part of the plant.

Reduction advantages

Mr. Cope questioned the advantages to be gained from a substantial reduction in size of purification plant since first, this would immediately give rise to an increase in pressure loss; secondly, smaller plant would contain less purifying material and the number of operations involved will increase, and thirdly, emphasis had been laid on the probability of much greater difficulty in disposing of spent oxide and should it become rubbish the need to work it up would be greater than ever. He asked whether it would not be wiser to retain the size of the installation and exploit any advantages of the new technique in the direction of saving the running expense of new oxide and reduce the weight of spent material to dispose of.

Mr. Thompson, referring to his forecast of developments in gas purification by oxide on [p. 19], said that there were many advantages to be gained by rapid rotation, but not all of them at once, *e.g.*, sulphur content could be worked up, but a simultaneous reduction in plant size was not possible. The loading of tower purifiers had confirmed that they could work at their full capacity throughout the year, *i.e.*, on base load. Where moisture content was concerned, one point was very noticeable when rapid rotation was practised; it was that the peak oxide temperature, so noticeable with 24-hour rotation, disappeared. The heat generated in the oxide mass was clearly lost to the atmosphere. The water evaporated at the temperature of the incoming gas was reduced and consequently the moisture content of the oxide was preserved.

Rotation increase

Mr. L. Copsey, N.T.G.B., Southall, thought that the meeting would be interested in some experiences gained in the operation of a set of tower box purifiers at Southall works where the frequency of rotation had been stepped up to 4-hour intervals.

This set of tower boxes comprising six towers, had a nominal capacity of 7½ mill. cu.ft. per day, with the conventional 24-hour rotational period, operated by the foreman each day. The crude gas came from an i.v.c. carbonising plant and had a sulphur content ranging from 600-1,400 grains of H_2S per 100 cu.ft., while the outlet was worked to the normal statutory limits. Live steam was now admitted to the main gas inlet whereas previously Newton Needle type steam heaters had been fitted at the inlet to each tower. Air was admitted to the second tower in rotation and its rate was adjusted automatically by a flow-ratio controller to maintain a pre-set proportion of the gas volume passed through the installation.

When the plant had been commissioned in late 1954, as an experiment, the outlet gas stream had been fitted with a continuous oxygen recorder, the cost of which had been fully justified. Some 18 months ago it had been thought desirable—by some means or other—to increase the load factor on the tower boxes, and in so doing to reduce the use of adjacent ground level purifiers, some of which had been required to cope with a rapidly increasing carburetted water gas output; a further attraction had been the economy of the high degree of mechanical handling not possible in the conventional purifier.

Mr. Copsey referred to [Fig. 2] in the paper which indicated how the efficiency of a box in first taker position declined quite sharply after some two to three hours but the oxygen recorder had shown that on a 24-hourly rotation, the revivification of the second tower was completed in three to four hours; the low oxygen figure recorded in the outlet gas for that period of time was followed by a rise which was maintained until a change in rotation had occurred.

These observations had led him to believe that a greater efficiency of the sulphiding of the mass of material, as well as an increase in load factor, would be possible by more frequent rotation of the system. When the necessary training of shift labour, which had taken some time, had been completed, the towers had been rotated first on a 12-hour basis, then at 6-, followed, as at present, by 4-hourly intervals. Judged by the past ten months' working, results had been encouraging; the load factor had increased from 7.5 to 10.5 mill. cu.ft. per day, with only an additional ½ in. w.g. differential across each tower, and it had been possible to operate a low rate of air admission—4% by volume—which gave an outlet gas oxygen content of .6%. So far the average sulphur content of the spent material had not risen significantly, and a turn out yields 50% sulphur on the wet basis.

Moisture movement

When a tower had passed approximately 80 mill. cu.ft. of gas as first taker, it was now the practice to discharge, crush, re-water and re-charge the 320 tons of material to the same tower. Starting with new bog-ore six such exposures were required to work the material up to fully spent condition. With full mechanical handling this was no great burden in practice it amounted to one tower box each week.

The movement of moisture within the material and more particularly its retention in the mass was an all important factor, and experience on the Southall installation had shown that there was a very close relationship between moisture content and efficiency of the material in use. An attempt to overcome the loss of moisture had been made by the introduction to the inlet gas stream of live steam thermostatically controlled to maintain a steady and regular gas temperature. The steady inlet gas temperature, and more frequent rotation, had had a marked effect on the temperature fluctuation across the set of five towers; in fact, the temperature curve, if plotted, was within 5° a straight line. The installation had manually operated valves, and a change of rotation was completed in less than ten minutes by two men, but they were considering a scheme for the power operation of the valves, which would make possible rotation at even shorter intervals, which as Mr. Thompson suggested, would be advantageous.

Mr. W. R. Dudden, N.T.G.B., Southall, said that the oxygen recorder installed in the early days of the tower purifiers at Southall had given the first indication that more rapid purifier rotation might be of benefit. When admitting air at the first taker, a steady outlet oxygen concentration had been indicated, but when admitting air at the second taker, an almost complete removal of oxygen had been experienced immediately after rotation, and the concentration of oxygen in the outlet gas had risen slowly for about five hours. After this it had rapidly increased until it was almost equal to the inlet oxygen content. The time required for oxidation on a 24 hour rotation had therefore been only 25%, but it was interesting that with 4-hour rotation it was now about 80%.

Referring to the smaller temperature rise across the purifiers as a whole and each individual tower as well, he said that the actual box temperatures followed the inlet gas temperature. This in turn depended on the atmospheric temperature, chiefly because the gas passed through ancillary plant and a long inlet main. Thermostatically controlled live steam was therefore admitted at the purifier inlet; (a) to maintain an inlet tower temperature of about 65°F. saturated during cold weather, and (b) to resaturate the gas when its temperature rose as it passed through the long main during the summer.

Loss of water from a purifier system could only occur in two ways, that required to saturate the gas for a rise in temperature from the inlet to the outlet of the system and that condensed in the system by contact with the cold sides of the towers or boxes. Conversely, little water could be replaced in the oxide by condensation caused by the small temperature difference between the gas and the oxide. Inter-tower coolers would, he thought, only aggravate the trouble, and some method of cooling the oxide itself was required. Perhaps wetting might be achieved by water sprayed to the oxide in the last taker position, but this would present considerable practical difficulties in tower purifiers.

Results at Southall

He did not entirely agree that the water content of the oxide charged to boxes should be decreased and the activity increased. Early results at Southall had indicated that the performance of an oxide was greatly influenced by its moisture content, and that roughly the sum of the moisture and the sulphur on the wet basis had been a constant figure. A special oxide with a moisture content of over 60% and an available iron of less than 14% had been obtained. Although other troubles in the purifiers had not permitted a complete trial, this oxide had worked rather better than the normal bog ore and had indicated that it could be worked to a high sulphur content in less changes than with the usual charge. It was difficult, he said, to re-wet oxide, and such moisture was retained largely on the surface, but he thought that if methods could be devised to retain the moisture in the oxide, it would be possible to work it to a completely spent condition without the necessity for any intermediate discharge.

Mr. Thompson, referring to oxide cooling, instanced an American set of purifiers installed abroad in a hot climate. This plant had been insulated with wood wool and fitted with water sprays. Working results had been excellent.

The size of the ammonia slip was interesting. Copperas and burnt oxide both needed slightly greater quantities for proper functioning. He was interested to hear about the oxygen content of the gas, determined by accurate means, being low after swinging and followed by a slow but steady increase until oxidation was complete.

Mr. H. L. G. Boot, Southern Gas Board, Poole, was interested in spent oxide. The market for it at present was very difficult, and the extraction of sulphur from it was important. He had inspected an extraction plant in Germany in company with some German gas engineers. The Ruhr gas plant dealt with oxide containing about 40% of sulphur, and there was very little tar. If tarry the extract was treated with sulphuric acid which effectively prevented contamination of the sulphur.

When the oxide was extracted with hydrocarbons such as toluene as referred to by Dr. Moignard, it was extremely active when recharged to the purifiers, and the final sulphur was free from tar. He asked for Mr. Thompson's views on the use of these hydrocarbon solvents. Referring to cyanide extraction from coal gas, he said that in Germany there was so much Prussian Blue appearing in the spent oxide that the routine was to have four or five extractions before sending the oxide to the chemical works.

Mr. Thompson said that with hot toluene extraction, there was a 90% recovery after cooling and allowing the sulphur to crystalise out. The remaining 10% was lost with the tar. There was in fact a patent lying in the archives of his firm which had been taken out for toluene extraction, but carbon bisulphide was a far better solvent for this purpose. An acid wash was necessary for a really pure product.

Mr. J. A. Hepworth, N.T.G.B., proposed a vote of thanks.

French hopes realised

THE Editor of the *Journal des Industries du Gaz* (formerly the *Journal des Usines à Gaz*), briefly reviewing the achievements of Gaz de France in 1959, comes to the conclusion that their hopes have been generally realised. The very warm summer had its repercussions in the consumption of all forms of fuel including gas but gas consumption in October (reported on another page) showed an increase of 0.7% on that of October, 1958. On the other hand long periods of dry weather facilitated the extensive programme of main laying work with which the industry was faced. Natural gas is already available in Paris, piped from Lacq in the South-West, 400 miles away.

For the future, the Editor writes: 'If for gas from Lacq 1959 has been a year of realisation, it has been equally so for the delivery to the coast of Algeria of the petroleum resources of the Sahara. Crude oil is arriving at Bougie and soon it will be the turn of gas. How is it to be brought across the depths of the Mediterranean? If the Methane Pioneer already seems to have justified transport in liquid form, the alternative is being studied of placing submarine pipes at a depth of about 3 km. (10,000 ft.). . . . Whatever method of transport may eventually be adopted no one doubts that gas from the Sahara *will* be brought across the Mediterranean.' 1959 would be marked as the beginning of negotiations on one of the most important questions of our time. Indeed, it had been stated recently that 'the movement of this natural gas may modify profoundly, not only the structure of the gas industry, but also that of energy supply throughout Europe.'

Among the technical features of this December issue are details of the arrival of natural gas to take over supply to the little town of Dole in the South-East, not far from Besançon; the third instalment of a lengthy study of some aspects, economic and commercial, of the distribution of natural gas in the U.S.A. and Canada; and a description of the space heating of the new headquarters of Gaz de France in Paris.

Gas connectors

A BRITISH STANDARD for plug-and-socket gas connectors for portable appliances (B.S.570:1959), concentrates almost exclusively on functional requirements. Applicable to plug-and-socket gas connectors for portable appliances using low pressure town gas, the specification deals with the following aspects of performance: Gas rate and gas soundness; operation of taps and the suitability of connections, washers, nuts and fixing screw holes.

Shoppers will be able to identify British Standard plug-and-socket connectors by the mark 'B.S.570' which they are required to bear.

Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 3s. (Postage extra to non-subscribers.)

Technical developments

Pipe benders

ONE of the Chamberlain group of companies announces that to supplement its range of hydraulic pipe benders it has accepted the sole distributorship for Great Britain and the Commonwealth of the Swedish-manufactured Herber motorised tube bending machines, for cold bending thin walled tubes and sections to small radii.

These can be offered in two sizes, the model RBM-40 being suitable for steel tubes up to 1½in. diameter by $\frac{1}{16}$ in. thick, and brass 2 in. diameter by $\frac{5}{64}$ in. thick, and the RBM-60 for steel tubes up to 2¾ in. diameter by $\frac{1}{16}$ in. thick, and brass 2¾ in. diameter by $\frac{5}{64}$ in. thick.

A robust and generously dimensioned machine is the main essential for bending thin walled tubes and bearing this in mind, the machines have also been designed to ensure accuracy and speed. As standard, the machines are equipped for cold bending of thin walled tubes on the principle of the internal mandrel. The machine makes bending possible without filling material, and in spite of this the pipe retains its round section throughout the whole bending operation. Bending of rolled sections can also be done with special tools.—*Chamberlain Industries Ltd.*

Cold stitching

AN interesting repair was carried out recently, when a purifier at the Southall works of the North Thames Gas Board sustained a fracture, almost 30 ft. in length, to the top shell plates.

Parts of the fracture were through the bolt holes and resulted in shearing the bolts. When effecting the repair, new ones were temporarily put in place to hold the plates in position, the bolts subsequently being removed to achieve a good seal to the edges of the holes. The bolts were then permanently replaced after the fracture had been repaired.

The repair to the casting consisted of the Metalock process of first drilling lines of blind pilot holes across the fracture, removing a narrow channel of metal between adjacent holes, and inserting in the resultant cavities bonding metal known as keys, which were driven into each cavity one on top of the other. Tangential holes were then drilled —and tapped—along the line of fracture, and bolts were cold-worked into the holes. Keys and bolts were subsequently peened to achieve a high degree of molecular integration.

Metalock keys are made to fit the cavities created by drilling and excavating between the blind holes, and consist of a special alloy of a high tensile strength and temperature coefficient similar to that of the casting. The repair to the purifier was accomplished in the man-hour equivalent of nine days.—*Metalock (Britain) Ltd.*

Wet scrubbing

DUSTS, fumes, and mists—the unavoidable by-products of many industrial processes—often create unfavourable public relations and legal problems. With the use of Chemico equipment not only is this nuisance removed but in many instances these gases and materials can be recovered and utilised with resultant savings that more than justify the cost of the scrubbing process. The Chemico wet scrubbing process has proved to be one of the simplest and most efficient methods in those problems involving separation and recovery of liquid mists and extremely fine particulate matter.

Chemico gas scrubbers serve industry in three principal ways, the elimination of atmospheric pollution, the recovery of commercially valuable materials, and the cleaning of gases for process usage.—*Chemical Construction (G.B.) Ltd.*

Humidity controllers

A COMPLETE range of humidity controllers for two-position low and line voltage control, and low voltage proportional control has been introduced. Models in the range will control modulating or two-position motors or can be used to control pumps, motors and fans directly.

The new range of electric humidistats includes both two-position and proportional control.

The proportional controller is for use with a modulating motor and can be used for control of humidification and de-humidification in all the usual air conditioning applications. It has a range of 20-96% RH with a modulating range of 10% RH.

The range includes several types of two-position controllers, featuring both single and double throw switches. Two types of controller are offered; those using open contact snap acting switches which ensure a differential accuracy of 2% RH at mid-scale; and those using totally-enclosed mercury switches for heavy loads and use in hazardous atmospheres.

The range of controllers features human hair sensing elements which guarantee a high degree of stability. All models in this wide range of humidity controls are available now.—*Honeywell Controls Ltd.*

Tube-screwing

A NEW tube-screwing machine suitable for production work in the workshop or for use on site installations, has been developed by a London company.

The machine, model MGA-2, is designed for cutting taper male threads conforming to BS.21:1957 on tubes $\frac{1}{8}$ in. to 2 in. nominal bore inclusive, manufactured to BS.1387: 1957. Seven sets of B.S.P. chasers are supplied with the standard equipment covering this range, together with three lead screws—19, 14 and 11 T.P.I.

An advantageous development has been incorporated in the rotary diehead of this machine, as compared with other machines in the company's range, in the form of a self-opening mechanism, which automatically opens the four chasers when the pre-set length of thread is reached. This arrangement reduces considerably operating times and also provides exact reproduction of threads in form, diameter and length.—*Le Bas Tube Co. Ltd.*

Quenching car test

A PROTOTYPE tubular coke quenching car in operation at the Margam works of the Steel Company of Wales has recently completed a 12 months' service trial. This car, built at Derby, represents a completely new departure in the design of coke oven handling equipment, the chassis and underframe being entirely constructed of tubular members surfaced with various protective coatings, including an aluminium spray. After washing and repainting, which was carried out local to the coke oven battery, the car was available for further operation.—*International Combustion Ltd.*

Metal sawing

THE recently introduced Barson Rotor metal cutting circular sawing machine has the advantage that the head may be rotated when angle cuts are required, instead of the material to be cut being rotated which, in the case of long lengths, can cause inconvenience in the workshop.

The machine will cut tubes up to 3½ in. diameter and solid material up to 2⅝ in. thick. The machine can, if required, be supplied with complete cooling arrangement and with stand.—*J. C. Neville Ltd.*

Flame detector

THE Ultravision, relying on a revolutionary photocell is activated only by ultra-violet radiation in the wave band .2 to .26 microns. Completely insensitive to infra-red and visible radiation, set up by hot refractory or reflected light from other sources, the new device will even detect ignition electrode sparks. Now available as a complete unit incorporating its own heat block, amplifier and seal-off, it can be placed anywhere in the furnace to control either pilot or main flames, or can be situated so as to control both. The Ultravision, suitable for gas fired burners, can be directly substituted for the flame detector in rectification systems used by the makers.—*Honeywell Controls Ltd.*

Jigs and fixtures

DESIGNING jigs and fixtures calls for a high degree of technical skill and experience, and any system which can be devised to assist and speed the designer is very welcome. Woodside Die Sinking Co. Ltd. has brought to perfection the manufacture of a wide range of tooling aids, and can assist designers and tool room technicians in their search for the ideal solution to their particular problems.—*Woodside Die Sinking Co. Ltd.*

Acid fume removal

A NEW process (Pat. No. 826221) has been developed to rid power station and sulphuric acid plant stacks of their sulphur nuisance and to recover sulphur salts for use in the production of ammonium sulphate fertiliser. Ammonia gas is introduced into the flue gases between the economiser and the air heater. The gas temperature is not lowered and wet scrubbing is not used, therefore, the condition favourable for causing 'stack droop' is not created. The ammonia reacts in the gaseous phase with the oxides of sulphur produced by combustion of the sulphur contained in the fuel. The product is a fog of ammonium sulphur salts which are quantitatively removed as a powder from the gas stream in high voltage electrostatic precipitators. As extracted by this process it is a mixture of ammonium sulphur salts and fly ash but when separated from the fly ash the salts form the basis for the production of ammonium sulphate fertiliser.—*Chemical Construction (G.B.) Ltd.*

GAS JOURNAL

Readers' Enquiry Service

Details and coupons are given on the backing page

Trade Publications

A NEW publication by A.C.E. Machinery Ltd. describes the recently-introduced automatic weighing and bagging which is now a feature of the firm's debreezing screen. The rate of bagging is approximately 12 tons per hour. During Board of Trade approving tests, the machine gave 24 consecutive weighs with ±½ lb. on the nominal quantity. The method dispenses with a second man to operate the weigh-hopper and open the door. In the event of power failure the equipment can continue to be used as a manually-operated unit.—*A.C.E. Machinery Ltd.*

★ ★ ★

It took only four days, in the year 1666, for 13,200 buildings to be destroyed in the Great Fire of London. A year later, the Corporation of the City of London passed an act requiring 'buckets, ladders and brazen hand squirts to be available in each parish.'

In 1933, the Nu-Swift Engineering Co. Ltd. was formed; last year it published an attractive 94-page review of its fire fighting equipment. Liberally illustrated, the publication is of use in the home or on the works.—*Nu-Swift Ltd.*

★ ★ ★

Publication No. 80, *Holmes-Schneible multi-wash system* was recently published from Huddersfield. Well produced and easily read, the new brochure claims an efficiency of 99% of all particles above three and four microns.

Publication No. 79, dealing with the Holmes-Schneible 'SW' cupola collector, was published in June last year.—*W. C. Holmes & Co. Ltd.*

A technical publication concerning the Metro-Flex thermal storage system, gas tight sealing techniques and draught control for industrial boilers, has been published. Metro-Flex control can be applied to all Economic, Lancashire or water-tube boilers, up to any capacity, coal oil, or gas-fired.—*Metropolitan Engineering Co. Ltd.*

★ ★ ★

New leaflets from a London company illustrate the uses of Vulcascot rubber conduit strip, used for protecting leads crossing floors; Augur safety ladder feet, oil-resistant and with non-slip rubber pads; and Augur safety steps, platforms and trolleys.—*Vulcascot (Great Britain) Ltd.*

★ ★ ★

The development and design and construction techniques has led Whessoe Ltd. to concentrate on all-welded, spiral-guided gasholders. This enables the company to offer gas-tight storage in a form that gives decided advantages over the riveted version. These advantages are explained in a bright publication, No. 107, published from Darlington.—*Whessoe Ltd.*

Conveyor belting

RAPID development in the use of belt conveyors for the bulk carrying of heavy materials and the consequent demand for belts offering unusual resistance to shock loading and abrasion has led to the development of a new belt quality. By the use of a nylon weft in conjunction with a cotton warp, Gaflex belting is said to achieve a number of advantages which are dealt with in a new leaflet.—*George Angus & Co. Ltd.*

Readers' Enquiry Service

If you would like more information on products and services mentioned in the advertisement or editorial pages of the 'Gas Journal', fill in the coupons below, *one for each enquiry*, and send in unsealed envelope to **'Readers Enquiry Service', Gas Journal, 11 Bolt Court, Fleet Street, London, E.C.4.**

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NEWS SUPPLEMENT

No sale-price coal, affirms Minister

OPPOSED TO FUEL PROGRAMME CUT

THE Minister of Power, Mr. Richard Wood, said on January 20 that he will not agree to the cut-price selling of coal to get rid of stocks. He said: 'We would probably sell a bit more but it would be at the expense of current production which would only go to take its place.'

He was quite willing to discuss other methods of using coal—as a raw material and for solid fuel—which would be vital to the future of the industry. A review of research expenditure was already taking place.

Oil burners stay

During a tour of the gas, electricity, coal and steel industries of the North Eastern area, Mr. Wood said that no oil-burning power stations would be changed to coal to consume stocks, and long-term planning for nuclear power stations could not be altered.

The changeover to oil, he said, was made during a period of acute coal shortage. Contracts were made with oil companies for supplies of fuel and these could not lightly be broken. Nuclear development, too, must take place irrespective of coal stocks.

More economic

'I would be greatly opposed to any cut in our long-term programme,' said Mr. Wood. 'Although coal is a more economic fuel at present we should be making it quite impossible for concerns building these stations to get any practical knowledge about the application of nuclear power in Britain.

'By the turn of the century we should be putting ourselves very seriously behind our industrial competitors in the world.'

He was anxious to increase the consumption of coal by power stations and said it should be regarded as the primary fuel.

Policy statement on 'duplication'

THE view that duplication of services by the gas and electricity Boards was increasing the cost to consumers was put to the Ministry of Power recently by the Town Council of Saltcoats (Ayrshire).

The Ministry's reply stated that 'the Government's fuel and power policy is to ensure that the consumer's requirements are met at the lowest cost, with due regard to relevant social and economic factors; that their is fair competition between the nationalised fuel and power industries; and that the consumer is free to choose whatever fuel he thinks most suitable for his particular needs.'

Machines tape orders problem

Automatic machines to record telephoned coke orders have been installed in the North Thames Gas Board's Imperial House, Fulham. Incoming calls to the department vary from 10,000 a month at peak periods to 1,500 a month in summer. Congestion on the switchboard has been inevitable in the past, but as some 50% of calls are straightforward orders, which can be taken by the machines, clerks can be left free to deal with other enquiries. A special number is to be allocated by the G.P.O. for this service.

EDINBURGH VENUE FOR INSTITUTION A.G.M.—OVER 1,400 DELEGATES

FOR the first time this century the Institution of Gas Engineers will hold its annual general meeting in Edinburgh. Attendance will number over 1,400, comprising members from all over the United Kingdom and representatives from the gas industries of many Commonwealth, European and other overseas countries.

Business sessions will be held in the Usher Hall, Edinburgh, on the mornings of May 31 and June 1 and 2. In the afternoons, parties of delegates will visit a number of industrial centres in central Scotland.

Six papers will be presented at the conference. The two major Scottish contributions are a paper by Mr. T. S. Ricketts, Chief Engineer of the Scottish Gas Board, on Britain's first Lurgi pressure-gasification plant which the Board are building at Westfield in Fife; and a paper on 'The Development of the Industrial Gas Load in Scotland' by Mr. A. Higgs, the Board's Industrial Gas Sales Development Officer, and Mr. R. W. Deans, Industrial Gas Sales Officer in the Glasgow and Western Division.

This year's President of the Institution is Mr. Duncan Dewar Melvin, Member of the Scottish Gas Board.

Coke circle invites women

The London and Counties Coke Sales Circle recently met for an open forum on 'Coke at Home'. The Circle welcomed representatives from the various women's organisations, including the Women's Gas Federation.

PERSONAL NOTES

MR. D. S. DOUGHTY, MR. D. B. SWORD and MR. D. TURNER have been appointed to the work study department of the Scottish Gas Board's divisional H.Q. at Perth. Mr. Doughty is at present Technical Assistant at the Dundee undertaking of the Scottish Gas Board. He is a graduate of the Institution of Mechanical Engineers. Mr. Sword (25) is a member of the Institute of Industrial Technicians and has been employed with various Dundee firms, mainly in work study. Mr. Turner (32) holds certificates in marine and mechanical engineering. He joined the Scottish Gas Board at Alloa in 1955.

MR. F. A. RHEAD, Eastern Gas Board engineer at Peterborough since nationalisation, has been appointed Production Engineer of the Cambridge Division of the Board and has moved to Cambridge. In 1945, he was appointed engineer, manager and secretary of the former Peterborough Gas Company and held these posts until vesting day. The present Works Engineer at Peterborough, MR. BRIAN SANTO, has been appointed to take charge of gas production in the city, and the Distribution Superintendent, MR. R. A. OSBORNE, will be supervising distribution at Peterborough, Whittlesey and Ramsey.

SIR HAROLD ROXBEE COX has been appointed Chairman of the National Council for Technological Awards, in succession to LORD HIVES, who has retired. Sir Harold has been Vice-Chairman of the National Council since its establishment in 1955. He was formerly chief scientist, Ministry of Fuel and Power, and is a member of the Council for Scientific and Industrial Research.

MR. EDWIN E. HEWETT has been appointed Sales Engineer for Nash & Thompson Ltd. of Surbiton, Surrey. Mr. Hewett was previously a specialist in ultrasonic flow detection techniques at Cossor Instruments Ltd. and is now responsible for the Nash & Thompson sales of the KOVO polarographs and the electron microscope throughout the United Kingdom.

MR. L.W. NOBLE, formerly manager of the North Shields branch works of Cockburns, Ltd., is now Manager, London office. MR. W. A. DUCKWORTH has been appointed Manager of a new office which has been opened in Manchester to serve, particularly, the chemical processing industry.

SIR HOWARD ROBERTS, C.B.E., has been re-appointed part-time Member of the South Eastern Gas Board.

MR. A. CUSINS has been appointed Manager of the London office of Belliss & Morcom Ltd.

Home laundry and central heating to dominate Gas Council stands

LATEST DEVELOPMENTS FOR IDEAL HOME SHOW

THE latest developments and designs in gas appliances will once again be on show when the Daily Mail Ideal Home Exhibition opens at Olympia on March 1. The Gas Council will have three separate exhibits.

One will take the form of a lounge where visitors can sit and watch demonstrations of washing by gas. On show will be washing machines and boilers, gas/electric washing machines and gas-heated drying cabinets.

'Welcome to Mr. Therm's House-Warming,' is the title of another of their displays which concentrates on gas heating with small-bore gas central heating and controlled warm air heating.

The third Gas Council stand will demonstrate central heating by coke.

Parkinson Cowan Appliances Ltd. will exhibit the Renown Seven, the first British gas cooker to incorporate the Magitrol—a hotplate thermostat which prevents boiling over and eliminates burnt food. Also on view will be the Prince and the Renown Six.

Built-in

The New World 72 designed as two separate units—hotplate and oven—will be exhibited by Radiation Group Sales. They can be built into fitted furniture and located in whatever position the housewife chooses. The New World 33—the latest in small gas cookers—and the New World 200 refrigerator and water heaters will also be on show.

Stoves Ltd. will be showing their latest designs in Newholme cookers, including the X7A, with elevated new-look griller, and the 152A Kitchenette, both with hotplate ignition.

The gas appliance division of Allied Ironfounders Ltd. will be showing the Cavalier gas cooker which has eye-level grill, plate-warmer and four boiling burners with automatic lighting; and the Leisure-Liberty cooker which is completely new in design and is specially suitable for fitting into modern kitchen units.

R. & A. Main Ltd. will be showing their latest range of gas appliances which include cookers, space and water heaters, the new Thermcold refrigerator and the Morley 59 series of gas home laundry appliances.

Spit roasting

Cannon (GA) Ltd. will be showing their new Cannon cooker which incorporates open spit roasting, large Fold-away open grill, and the first spill-over sealed hotplate.

The Autocrat fully-automatic cooker and the Envoy 111 will be prominent in the Sidney Flavel display, and the Courier small space cooker and the National No. 20 sink water heater will also be on view.

Included among the exhibits of Thomas Potterton Ltd. and Perkins C.M.E. Ltd. will be wide ranges of gas-fired boilers.

CORRESPONDENCE

Whence 'niting'?

DEAR SIR,

Webster's *New International Dictionary* gives: 'Nite—verb transitive (Old Norse). To deny; abjure; refuse. (Obsolete).'

A 'niting washer' is therefore one which denies or refuses movement, i.e., acts as a stop.

Yours faithfully,

H. R. HILL,

Bratt Colbran Ltd.,
Lancelot Road,
Wembley,
Middlesex.

January 18, 1960.

COMING EVENTS

January 27. — THE INSTITUTION OF MECHANICAL ENGINEERS: 1, Birdcage Walk, Westminster, S.W.1. 'Technical and Economic Aspects Covering the Ocean Transportation of Liquid Methane,' by Dr. J. J. McMullen.

January 29.—NORTH THAMES G.C.C.: Westminster City Hall. Council meeting at 2.30 p.m.

February 1.—THE SOCIETY OF ENGINEERS: Burlington House, London, W.1. Presidential address by E. G. Massy Collier. 5 p.m.

February 2.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster, S.W.1. Council meeting at 2.30 p.m.

February 3.—SCOTTISH G.C.C.: 26 Drumsheugh Gardens, Edinburgh. Council meeting at 11.30 a.m.

February 4. — MANCHESTER JUNIORS: Gas showrooms, Manchester. 'Bearings and Lubrication' by Hoffmans Ltd. 6.30 p.m.

OBITUARY

MR. WILLIAM JOHN HURN, who retired just over two years ago after more than half a century with the gas industry, has died aged 68. Mr. Hurn joined the old Clevedon Gas Company at 14, and rose to become maintenance superintendent. When the industry was nationalised, he carried on as district manager for Clevedon and the nearby town of Portishead.